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Strategies and Methodologies for the Planning, Design, and Implementation of Information Systems in Public Administration

Proceedings of the international conference held in Beijing, China, 23–28 May 1988

Data for Development International Association

June 1989

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This series includes meeting documents, internal reports, and preliminary technical documents that may later form the basis of a formal publication. A Manuscript Report is given a small distribution to a highly specialized audience.

La présente série est réservée aux documents issus de colloques, aux rapports internes et aux documents techniques susceptibles d'être publiés plus tard dans une série de publications plus soignées. D'un tirage restreint, le rapport manuscrit est destiné à un public très spécialisé.

Esta serie incluye ponencias de reuniones, informes internos y documentos técnicos que pueden posteriormente conformar la base de una publicación formal. El informe recibe distribución limitada entre una audiencia altamente especializada.

IDRC-MR235e

STRATEGIES AND METHODOLOGIES FOR THE PLANNING, DESIGN, AND IMPLEMENTATION OF INFORMATION SYSTEMS IN PUBLIC ADMINISTRATION WITH SPECIAL EMPHASIS ON ECONOMIC INFORMATION SYSTEMS

Proceedings of the International Conference held in Beijing, China, 23-28 May 1988

Organised by the
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We would firstly like to express our gratitude to the Government of the People's Republic of China for their full involvement in the preparation of the conference and for its perfect organisation. Our thanks go especially to Mr. Zhang Shou, Minister, Vice Chairman, State Planning Commission and President, State Economic Information Center, to his colleague Mr. Ding Di Qing, Deputy Director, State Economic Information Centre, and to all the staff of the China State Economic Information Centre. At the same time, our thanks go to the China Association of Science and Technology, and especially to Mrs. Wu Ganmei, Director, who played a major role in the local organisation of the conference and in its logistics.

Then we would like to express our deepest thanks to the United Nations Development Programme for having accepted to co-sponsor the conference and to fund participants from developing countries.

We would like to express our gratitude to the Federal Government of the United States for their continued interest in DFD activities and for their financial support without which the conference could not have been held.

Our special thanks go to the International Development Research Centre of Canada, and especially to Mrs. Martha Stone, for their continuous co-operation with DFD and for helping to fund participants from developing countries.

Of course our warm thanks go to the Conference Committee, which designed in very careful detail the conference and chose all speakers and chairmen.

Last, but not least, we would like to express our gratitude to all participants for their contribution to the success of the conference. Additional thanks go to the speakers and working group chairmen for their active involvement throughout.

The Data for Development International Association brings together individuals and institutions involved in the planning, building and use of information systems in public administration for a permanent exchange of experience and development of common concepts, strategies and methodologies.

Data for Development has nearly 200 members from 70 countries. Its headquarters are located in Marseilles, France, and are based in CESIA premises, which is the French Agency for Information Systems in Public Administration.

Among its various activities, Data for Development organises every two or three years an international meeting on a specific topic related to information systems in public administration. The previous meeting, held in Dakar, Senegal, in 1986, was devoted to the role of information technologies to increase productivity in public administration. At that meeting, the Chinese Government delegation invited Data for Development to hold its 1988 meeting in China. The main theme selected for that conference was "Strategies and methodologies for the planning, design and implementation of information systems in public administration". On the suggestion of the Chinese Government, a subtheme was added on "economic information systems", especially relevant for many developing countries and particularly for China, which has a large and ambitious project of a State Economic Information System.

The meeting raised considerable interest among decision makers and specialists from China and abroad. The meeting in Beijing brought together 158 participants from 31 countries. Among the participants were ministers as well as information systems specialists, and individuals involved in research projects related to economic information systems.

The participants to the conference were honored to have the following public figures chair the opening cermonies : Mr. Li Tieying, Chairman of the State Education Commission; Mr. Zhang Shou, Vice Chairman of the State Planning Commission, and Director General of State Economic Information Centre; Mr. Xie Qimei, Under Secretary General of the United Nations; Mr. Wang Daheng, Vice Chairman of the China Association of Science and Technology; Mr. Song Zhiyuan, Vice Minister of Telecommunications; Mr. Guo Pingxin, Permanent Adviser of the International Association for Processing of International Information; Mr Shi Ling, Director General of the Board of the State International Economic Information Centre.

The meeting was held over a four and a half day period. Plenary sessions were held in the morning, with the presentations of position papers on daily themes. The topics of the plenary sessions were :

- State of the art in economic information systems
- Critical review of economic information systems
- Methodologies for planning, design and implementation of information systems in government
- Case studies on practical use of methodologies
- Guidelines for government policies

In the afternoon participants gathered in working groups where background papers were presented and discussions were held on each working group subject. There were 6 working groups which dealt with the following issues :

- Methodologies for planning, design and implementation of information systems
- Practical ways and means to take into account planners and decision makers needs in the data collection process and in the

planning and design of information systems for administrative operations

- Interdepartmental standards concerning data, software and hardware
- Ex-post evaluation of information systems
- Decision supporting tools (expert systems, spreadsheet packages, simulation tools, models)
- Macro economic information systems and their use by governments and enterprises

The papers presented in plenary sessions, the working group reports and the background papers presented in working groups are published in the proceedings.

The overall appraisal of the conference proved to be very positive, following a survey made on the last day of the conference. The following are some of the results gathered from the survey :

1. General overall appreciation of the conference
7% exceptional — 10% good
76% Very good — 7% Fair

2. Theme : was it a good idea to combine 2 themes (strategies and methodologies/economic information systems)?
82% yes — 18% no

3. Duration : Was 1 week with 1 day break
90% appropriate — 10% too long

4. Plenary Sessions

4.1. Quality of papers
5% excellent — 55% good
35% very good — 5% fair

4.2. Length of speeches (30-45 minutes)
82% appropriate — 12% too long
6% too short

4.3. Question period after each presentation (10 minutes)
77% appropriate — 8% too long
15% too short

4.4. Roundtable (content and time)
80% appropriate — 8% Not appropriate
12% no answer

Aside from the obvious quality of the papers and working group reports in the proceedings, other positive results have been obtained from the conference. Contacts made between participants led, in many cases, to the creation of projects between different countries and international working groups. Among these projects, a DFD international working group on economic information systems was created. This working group will start its work in 1989.

The subject of strategies and methodologies related to information systems in public administration needs more development than ever. Data for Development will carry on taking initiatives in that field. In that respect, a project of a European methodology for planning, design and implementation of information systems, called METHOD 92, is worth mentioning (this project is being launched by the countries belonging to the Economic European Community.)

It is proposed that the next Data for Development International conference be held in the winter 1990/1991.

Jean Salmona
Director General
Data for Development

Les actes sont également disponibles en français et en chinois

The proceedings are available in French and Chinese

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STATE OF THE ART IN ECONOMIC INFORMATION SYSTEMS

THE KEY TO A MODERN, PRODUCTIVE, EFFICIENT PUBLIC ADMINISTRATION : THE NEW INFORMATION SYSTEMS

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Public administration is a necessary evil. In all countries, it is a burden for the economy : its expenses, in a way, are the nation's overheads. If a government does not want to jeopardise the competitiveness of the country's economy, it cannot increase the budget of public administration ; however, its tasks are increasing everywhere in the world. The laws and regulations it has to apply are more and more complex. It is in charge of the macro economic control of the country. It prepares and implements the economic and social decisions of the government.

These two functions imply two categories of information systems : information systems for administrative management and information systems for macroeconomic control and decision support.

In fact, information systems in public administration should be subsets of one general information system, which would be public administration itself. Precisely, information technologies and especially new information technologies are likely to bring major changes in the organisation of information systems in public administration and therefore in the organisation and working procedures of public administration itself.

1. Information systems in public administration evolve with new information technologies

First, the objectives of information systems for administrative management are to increase the productivity in public administration (make it possible to perform more tasks with the same resources or the same tasks with reduced resources) and to increase its efficiency (i.e. apply laws and regulations properly).

The objectives of information systems for decision support are to optimise government decisions and to provide the government with the information it needs to define and conduct its economic and social policy.

Originally, information systems for administrative management were large systems, centralised, often structured around national registers, i.e. large computerised files related to basic entities (individuals, enterprises, buildings, land parcels etc.). Information systems for decision support were also, originally, large systems divided into two categories :

- quantitative data banks (mainly statistical data banks), containing economic and social data
- document handling data bases (especially related to regulations and technologies).

In these two fields - management and decision support - new information technologies have given birth to new types of information systems, very different from the former ones. These technologies are decentralised, user oriented - users are able to use them without the help of specialists - and most of them are light, flexible and do not necessitate heavy investments. This is true especially for micro computers, which can be substituted to minis and mainframes for many of their former applications, and for technologies like expert systems, micro processor cards, etc.

New information systems are mainly based on these new technologies. Moreoever, they closely associate informatics and telecommunications. Based on an intelligent workstation (a micro computer connected to a local area network and, through it, to external information systems), they make it possible for the user to perform his administrative management tasks, his personal office work, the preparation of his decisions, and communication with other work stations inside and outside the organisation.

Series of local area networks, each of them limited to an administrative building, replace large centralised systems. From his workstation, any individual can manage his own files, prepare and disseminate his reports, access to information systems (internal or external to his organisation), from which he can extract the data he needs in order to process them. The local area network offers common services provided by specialised computers such as electronic mail, archiving, etc.

These new systems make it possible to increase in a considerable way the efficiency of administrative management, the productivity of public administration and the quality of government decisions, as they allow the possibility for a change in individual behaviours and as users are no longer dependent on external constraints.

2. This evolution makes strategies and methodologies even more necessary than ever

The more the systems are decentralised, the more distributed hardware and data are, the more it is necessary to have standards, strategies and methodologies.

First, standards are indispensible to make the whole system work : data standards, in order to make communication between different departments and ministries and the exchange of data on the same entities possible, network standards in order to make communication between computers and networks possible.

Strategies and methodologies are necessary to prevent waste of resources, which is a risk linked to decentralisation, and to optimise their use.

As concerns strategies, one must notice that information technologies have brought rather little change in public administration during the past fifteen years, owing to the fact that they were introduced in public administration as automation of manual procedures whereas at the same time organisational structures and working procedures were not changed.

Therefore one must change at the same time organisational structures, working procedures and information systems ; especially, any study related to the study of information technologies should start with an evaluation of the organisational structures and an analysis of the working procedures and then, and then only, the technical study should take place.

There are three categories of actors :

- hardware and software manufacturers

- computer specialists

- end users, i.e. professionals in public administration.

The hardware and software manufacturers want to maximise their profits and to reduce competition ; their interest lies in the absence of standards and the capture of clients. Besides, their sales forces are strong enough to influence procurement in public administration and to increase the rate of hardware and software change more than necessary, claiming often that new technologies are better.

The powerful lobby of computer specialists has developed in public administration out of classical administrative strcutures; its objective is to increase its influence and therefore it has a computer procurement and a systems development policy which is not necessarily consistent with the needs of end users.

End users should be the most important actors. They should have the main role in the design and implementation of information systems.

First, to optimise the use of resources, one should implement in every administration agency the concept of integrated **information resource management**. According to that concept, all information resources (men, computer hardware, software, organisational structures, working procedures, funds) should be managed as a whole.

Besides a general strategy should be implemented at the level of the whole public administration at the same time as in each ministry and in each department.

Last but not least, the development of information systems in public administration has to be carefully monitored by end users and by the whole government. This implies:

- generalised strategic planning of information systems, therefore strategic planning methodologies leading to the production of master plans;

- the optimisation of informations systems' design, which needs methods for the design of information systems;

- a careful preparation of information systems implementation which implies the existence of methods for project management, systems analysis and programming;

- an audit and a systematic evaluation of the results which implies methods for auditing and evaluating.

These methods make it possible to optimise planning, design and implementation. They have another major advantage: if they are widely spread in public administration, known by all civil servants and not only by information technologies specialists, every individual talks the same language as concerns information systems, every individual thinks about the development of information systems in the same way as his colleagues; therefore, methodologies facilitate the building of teams of specialists as well as discussion at all levels of public administration between users and specialists.

For that reason it is necessary to choose one method only for each of these fields, especially for strategic planning and design, not only for a given department but if possible for the whole public administration.

These methods are precisely the subject of the Beijing conference. The international association Data for Development was created in 1975 by a group of government offficials in various countries not all of them were specialists in information technologies. The objective of Data for Development is the exchange of experience between indiviuals and institutions concerned with the development of information systems in the public sector in various countries. In particular, DFD aims at establishing common platforms and at defining common strategies so that each member can benefit from the experience of his colleagues.

Data for Development has created the concept of **government data network** (GDN). The first approach of that concept and of the related strategy was published in 1976 (Data and Development, National Technical Information Service, Washington).

Since its creation, DFD has held a series of conferences. The subject of the last one, held in Dakar, Senegal in 1986 was "Increase of productivity in public administration: the role of information technologies".

At that conference, the delegation of the Chinese Government, conducted by Mr. Zhang Shou, Minister, Vice Chairman of the State Planning Commission, President of the State Economic Information Center of the People's Republic of China, offered to hold the next DFD conference in China, and suggested that its subject should be "strategies and methodologies for planning design and implementation of information systems in public administration.

As the State Economic Information Center of the People's Republic of China has launched a major project for a state economic information system, we felt it useful to put emphasis in our conference on economic information systems.

International cooperation on approaches and strategies concerning economic information systems and methods for planning, design and implementation of information systems used in public administration is likely to develop between industrialised countries and countries of the Third World; this is quite a new field for cooperation as most countries have developed their own methodologies or used methods suggested by hardware manufacturers.

By exchanging their experience and presenting it through the proceedings of the conference to all countries in the world, the participants in the DFD conference contribute to a better mastering of information technologies which are likely to be, in the next ten years, the catalysts of a radical change in the organisational structure and in the efficiency of public administration, therefore of governments and states.

STRATEGIES AND METHODOLOGIES FOR THE PLANNING, DESIGN AND IMPLEMENTATION OF INFORMATION SYSTEMS IN PUBLIC ADMINISTRATION WITH SPECIAL EMPHASIS ON ECONOMIC INFORMATION SYSTEMS

THE CASE OF MARKET ECONOMIES

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INTRODUCTION

Throughout history, public authorities wishing to act on economic and social events in the territories which they administer have tried to obtain information necessary for the realisation of their objectives. In Antiquity, these were generally data on the production of wealth, specifically in agriculture.

In modern times, with economies becoming more complex and diversified, we have witnessed the development of social and economic information, primarily statistics. This development started initially in an uncoordinated way, the data in each area being collected exclusively to satisfy the needs of the specialist of that area. Sectoral information was highly developed but it did not provide a global view of the economy, nor did it contribute to solving problems involving different areas.

This explains why the 1950s and 1960s are characterised by an effort to organise statistics into a consistent information system. In such a system, all entities which have to be measured are defined by very precise concepts used by everyone and by classifications. A specific variable has in the whole system a unique value. Defining relations between different areas must be possible.

The development of systems of national accounting followed the search for statistical consistency. Modern systems provide in fact a general framework for grouping together all economic statistics and for relating the various classifications.

The computer revolution in recent years and the emergence of new information management techniques have led to a new stage in the development of statistical systems. Within a few years, all administrative departments in the developed countries and most enterprises, starting with the larger ones, have computerised some management functions. They have built - once again in an uncoordinated way - information systems based, in general, on files containing information at the most detailed level. The mobilisation of these files, which is technically possible, constitutes an important source of potential data. At the same time, the information needs of the economic agents increased considerably.

Statisticians, who had also computerised most of their work, then became confronted with new problems of different types:

- Problems of a social nature: should statisticians have access to individual information which has been collected for non-statistical purposes.

- Problems of consistency: extend to the individual level the need for standardisation of concepts and of methods of measurement which have been set up at the partly-aggregated level.

- Technical problems: how to make possible communication between different information systems which have been set up on different computers with different software ?

Information, and specifically economic information, is often created through an action by economic agents, and in particular by enterprises. In a market economy, these agents are in most cases private agents, and the information is their private property.

Governments, wishing to develop a system of public information to satisfy their own needs, and also whenever possible, the needs of the various economic agents, need to use the power of legislation to force agents to supply the information in a format which makes it possible to use the data. At the same time, governments must ensure that the constraint imposed on economic agents is not heavy and costly.

Private organisations are also able to collect, process, and disseminate economic and social information generally as a commodity, i.e. by selling the information. In various countries, we can see the coexistence and development at a different pace depending on the country, the time, and the sector, of public information and private information, of information which is freely available and information which has to be purchased.

The rest of this paper will provide a general overview of the practices in industrialised countries in market economies relating to public information systems. We shall start with the methodologies of central economic and social statistical systems, followed by systems of administrative organisations and infra-national units. We shall then present the implementation of these systems.

I. THE CENTRAL SYSTEM OF ECONOMIC AND SOCIAL STATISTICS

The aim of this system is to provide public administration and other economic agents with the quantitative information which they require to develop and implement their policies. The most aggregated form of this system is made up of the National Accounts. Statistics constitute an intermediary level. In modern times, it is necessary to include in this central system all the elements which make it possible to identify at the national level all economic units and the economic flows linked to them.

Nearly all developed countries in market economy have adopted a system of national accounts which is more or less directly derived from the United Nations System of National Accounts (1968 edition, currently being revised). These accounts include three sets of accounts of flows which in different countries are more or less integrated.

The first set describes, often in the form of input-output tables, production operations and the resources and employment of goods and services. The second distribution, redistribution and utilisation of revenue. The third describes, with the help of appropriate classifications, the financial operations. In a small number of countries, the flow accounts are completed by accounts of material and financial stocks, or by accounts of assets.

The system of National Accounts has a double objective. On the one hand, it describes the main economic flows in a country, and can thus serve as a basis or a skeleton for the simulation of macro-economic models. Short-term and medium-term projections of future national accounts are prepared by or for many governments. These serve as a general framework for the preparation of annual financial budgets and sometimes for medium term plans.

On the other hand, the system of National Accounts is designed to serve as a general framework for the bulk of economic statistics. It contains in fact a set of classifications which make it possible to describe in a consistent way the main economic phenomena.

In most countries, the national accounts are stocked on computers; this facilitates the publishing of the accounts and their integration into models as well as further processing of the information. However, the preparation of these accounts from detailed or partly-aggregated statistical data, which will be discussed later, is rarely automated perhaps with the exception of external trade data.

It is not possible to describe briefly the economic and social statistics produced in each country. Of course, the same main areas are found everywhere, but it is remarkable to note that the importance and rate of development of each area in various countries differ significantly, and that it is possible to relate these very closely to the economic, historical and political specificities in each country. We shall now simply discuss two problems which at the moment generate a lot of debate in most countries: the use of administrative sources by statisticians and international standardisation in the field of statistics.

At all times, the administration of a country has required that the central or local authorities collect information on the various entities which have to be managed, and constitute files, previously kept manually, then on tabulating cards, and now on computer storage media which can be easily mobilised. The information relate to entities which statisticians are trying to count using other means: employment, revenue, taxes, sales, purchases, etc. Tax and social security administrations, in particular, collect a vast amount of quantitative information. These administrations thus possess a very important source of potential data for statisticians.

There are advantages and disadvantages in using this source of data. The obvious advantage is of an economic nature both for the statistician and for the agent who has to supply information. The ideal here would be that an information which is useful in many departments (including statistics) is supplied only once by an agent. Furthermore, an information supplied for administrative purposes can be better verified than one supplied for statistical requirements only.

There are two types of disadvantages. The first is of a statistical nature: administrative departments use concepts and classifications which have been designed by themselves; they only control those magnitudes which are important for them. Thus, this management information may not be satisfactory for statistical purposes. The second disadvantage relates to the protection of confidentiality.

Different countries have adopted different attitudes vis-a-vis these contradictory requirements. The extreme cases are on the one side those countries where the official statistics organisation may have access to administrative files, on the other side, those countries where there is no transmission of data between administrative departments and the statistics organisation. In the first case, it would be logical for statisticians to participate in the design of information systems which are implemented in administrative departments; this rarely happens. In most cases, the practice adopted lies between the two extremes. It is quite common, for example, for administrative departments to derive themselves statistical information from their management files or to provide survey samples to statisticians.

The development of international exchanges is an important characteristic of the second half of this century; the international nature of the economy requires the standardisation of national statistics. To satisfy this need, international organisations, and specifically the United Nations, have recommended that standard statistical concepts, classifications, and methodologies should be adopted. This poses some problems for national statisticians and the current situation is that where each country maintains its own national system from which data required by the international organisations are retrieved more or less satisfactorily.

Such a situation must surely create problems for those economic agents concerned with international economic exchanges.

The basis of the central system of public information is made up of a collection of dispersed information which arise in the context of various economic activities. To transform this collection of elements into a consistent whole, which can be used by public authorities and the public, a certain number of conditions are required. It is necessary, in particular, to identify the basic entity with which each information is related, and be able to interpret this information correctly.

Concerning information which originates from individuals or households, the traditional modes of identification of persons, (surname, name, filiation, address,) are still being used. These are not very convenient for computerised data processing, and there have been attempts to replace them with numeric codes, or at least to associate them with such codes. These codes are allocated either by a central organisation which makes them available to all administrative departments, or by each department for its own needs. Recent developments in data processing makes this numerical transposition less indispensable than was thought a few years ago.

Some countries have created, from these identifiers, files of persons; the information contents of these files vary significantly from country to country. When they exist, these files are usually managed by a statistical organisation.

The situation is more complex in relation to enterprises since the characteristics which define precisely a unit are more variable than for an individual. Here again, identification numbers for enterprises or establishments have been defined either centrally or by each department for its own use, particularly by the tax administrations. Files containing certain information on each enterprise have been created. Some of this information, in general, the name, the address, the principal activity, and sometimes an indication on the size of the organisation, can be obtained by the public.

One of the difficulties involved in setting up a public system of statistics lies in the proper understanding of the data which has been collected either through a survey or from administrative sources. Each economic agent may indeed give a different meaning to the different words which appear in a questionnaire, such as "revenue", "profit", "turnover", "number of employees", etc. To improve the situation, some countries have developed an accounting framework for enterprises where the measurement of the different flows and stocks are defined as precisely as possible. The use of the standard accounting framework is sometimes prescribed by regulations, but more often, it is used by general agreement.

II. THE INFORMATION SYSTEMS OF ADMINISTRATIVE ORGANISATIONS

We have already mentioned the fact that in modern states, the various administrative departments have to computerise their management. It can be said that these information systems form part of the public information system, since on the one hand, they have been set up to provide information for public administration, and on the other hand, they are a source of data for the Central Statistical System.

The first such systems were designed by each organisation to satisfy its own needs, and generally set up as a centralised system. The data processing services of the administration thus surveyed the requirements of the various sections, and determined using certain methodologies the system required with the appropriate hardware and software. The basic information was entered and processed centrally, and distributed to the various services.

The introduction and generalisation of microcomputers has modified the design of these systems, making it possible to develop modular information systems supporting more decentralised management of large administrative units. The decentralised units enter all the data needed for administration, process what is useful for their own management, and transmit to other levels only information needed for management at these levels or for statistical purposes. Obviously, methodological co-ordination is even more indispensable when data collection and entry is decentralised.

The development of information technology also contributes to improvements in activities which take place before or after the information systems of administrative organisations.

Before, in that the collection of external data is no longer limited to the written form, but includes the use of viewdata, or direct links between the computers of enterprises and those of public administrations, or more often, the transmission of diskettes. Experiences are being carried out for survey staff to use portable microcomputers.

After, in that the offices of the large administrative organisations are being automated, thereby transforming the conditions of execution of certain tasks and of transmission of data.

This review of the problems encountered in the design of information systems in public administration would not be complete if we do not mention that in some countries, there are sub-national territorial administrations which have sufficient autonomy to design information systems which are relatively independent from the central system of statistics. This is specially the case in countries with a federal structure.

In some cases, this independence is limited. There are indeed cases where a significant amount of the statistical work of the States which make up a Federation are indeed part of national statistics based on a methodology determined by the Federal administration. Furthermore, economic considerations often induce the sub-national administrations to use the same information systems which have been designed and tested by the central administration.

In other cases, on the contrary, national statistics are entirely produced by Federal organisations, and there are no contributions by the statistical organisations of the States.

Naturally, the central statistical system, with its three levels of information, and the partial systems are not independent. It can indeed be argued that it is the quality of the basic information collected from the economic agents which determine the quality of the statistics and the national accounts. But a complete integration of the statistical system where macro data is obtained by summing micro data is at the moment indispensable.

It is therefore necessary to have a minimum degree of integration in the whole system of administrative information. This requires that all administrative statistical services use certain common identifiers, classifications derived from the National Accounts wherever possible, and common accounting methods. It would be optimistic to believe that this is actually the case.

On the other hand, it is necessary to relate as much as possible the partial systems between themselves and with the central system. This is particularly important for enterprises from which information is collected many times by the tax administration, by social security, through various statistical surveys, in the publication of the accounts and balance sheets, etc., each separate collection of data being used for creating separate databases in the corresponding administration. In general, the public does not have access to these databases given the confidential character of the data which they contain; however, there are exceptions for work of a scientific nature.

From these databases, it is possible to prepare a global summary for a large sector of enterprises; the summary being obtained by combination of the individual data. The global results would in general differ from those of the National Accounts since the production of the latter requires an arbitration between the values originating from the enterprises and those which originate from other sources. We can hope that progress in statistics will make it possible to obtain a better integration.

III. THE IMPLEMENTATION OF THE PUBLIC INFORMATION SYSTEM

We have seen in the previous paragraphs that there:

- is a lot in common in the practices of industrialised countries at the most abstract, and most general level of public administration information systems, namely at the level of the National Accounts,
- are more differences at the intermediary level, namely the statistical system,
- and even more difference still at the base level, namely the level of organisation by public administrations of standardisation and collection of elementary information.

There are also many differences in certain institutional aspects of the implementation of these systems, namely:

- the organisation of statistics services,
- the organisation of computer services,
- the organisation of the dissemination of information,
- the legislation covering the obligation to provide information and the protection of confidentiality.

1. The organisation of statistics services.

In most countries, there is a central organisation of statistics responsible for promoting the co-ordinated development of economic and social statistics. It is often assisted by a Council on which there are not only statisticians, but also representatives of various organisations. But the functions of the central organisation differ significantly from country to country, particularly with regard to data collection. In some countries, there is no data collection function, the latter being performed by the decentralised statistical services of the various ministries; in other countries, on the other hand, the central organisation has the monopoly of the collection of statistics and it does not receive information from other departments. Most countries have a system which lies between these two extremes.

The increasing importance of administrative data in ministries as a source of statistics may encourage a decentralisation of the statistics organisation.

In certain countries, the co-ordinating power of the central statistical organisation is strengthened by the existence of a cadre of government statisticians, which it manages, even though they are employed in other departments.

2. The organisation of computer services.

During the last twenty years, all developed countries are characterised by a rapid increase in the use of computers in the organisations responsible for the management of public information. In all countries, this development has followed a similar path, albeit at a different pace, starting with specialised computer services, responsible for all data processing, to a certain decentralisation linked to the multiplication of terminals, and finally, to a more distributed system with the generalisation of powerful microcomputers, the improvement of statisticians' knowledge of computers, and the development of more user-oriented software.

Naturally, for the central statistical services, the importance and organisation of their computer system depend on the responsibilities which they have for data collection, management of files, and dissemination of information.

In all countries, there are organisations responsible for computer co-ordination, but these have been successful mostly in relation to hardware, much less in relation to software, computer configurations, and formats.

Finally, it must be pointed out, that to our knowledge, there is no country where there is close and efficient collaboration between the organisations responsible for information development and co-ordination and those responsible for computer development and co-ordination. This collaboration is however indispensable for the development of more efficient and economical public information systems.

An information is only useful if it is received by whoever needs it; dissemination of information is one of the tasks of the statistics organisations. These organisations perform this task in different ways, either by doing all the tasks related to dissemination themselves : publishing, sale of publications, preparation and marketing of data banks, publishing of diskettes, etc., or by entrusting these tasks totally or partially to private organisations.

Still, an important portion of the public only receives economic information through the media: press, radio, television. Organising the contact with the media is an increasingly important task for public information organisations.

3. The legislation covering the obligation to provide information and the protection of confidentiality.

On this issue, we shall also be brief, by simply raising three points:

- Legislation is necessary to compel private economic agents to provide information which is necessary for public systems. In many countries, there is a "Statistical Act" which specifies the conditions of the obligation, and allocates to a specific organisation the responsibility for defining the compulsory surveys and censuses. In other countries, an annual vote in Parliament is required to decide on these points.

- In all countries, legislative or customary regulations do not allow the publication by public organisations of individual data whenever there is a confidential element.

- Finally, the development of computer files and the theoretical possibility of combining them has given rise, in all countries, to an organisation responsible for ensuring that this possibility is not used in such a way that it threatens individual liberty.

CONCLUSION

During the last 30 years, the public system of economic and social information has been deeply transformed in its nature, in its methodology and in its conditions of implementation. This transformation is continuing with the emergence of new information techniques, such as for example very cheap memory and storage devices, the development of cards with storage facilities, the applications of artificial intelligence.

We have seen in the preceding pages that even in the most developed countries, the public system of social and economic information was not sufficiently simple and consistent to satisfy those who believed that any piece of information which arises from an economic activity should be immediately captured, processed and transferred to all those who may need it.

Technical developments make it possible today to design more complex systems which are very decentralised. One of the current tasks for public administrations is to implement such complex decentralised systems, while at the same time maintain control over the whole development.

OVERVIEW OF ECONOMIC INFORMATION SYSTEMS IN PLANNED ECONOMIES IN EASTERN EUROPE

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1. SCOPE OF ECONOMIC INFORMATION SYSTEMS

The main types of Economic Information Systems (EIS) playing an important role in managing the economy in the Eastern European countries with planned economies are as follows :

(i) overall central economic statistics produced and operated by the Central Statistical Offices for planning of national economy as a whole and its main domains ;

(ii) information systems of the functional and the branch ministries (the Ministry of Finance, the Ministry of Labour, the Ministry of Industry, the Ministry for Food and Agriculture, etc.) responsible for a given area and branch of the national economy ;

(iii) economic information collected and produced by local governments (of cities and counties) for guiding the economic affairs of their region.

Among EIS central statistics play a dominating role in all countries. However, they can't satisfy all the information needs of ministries and national authorities for performing their basic - professional, authority and state ownership - functions. The three basic functions involve special informational features. For the professional functions, information is needed both from the scientific and practical aspects about the present situation and the perspective of the branch at home and abroad, including research, development, operations, production and other problems to be solved. The function of authority rises from the most pragmatic aspects of life; in addition to professional data, it requires information to set up rules, orders, standards, norms, or to determine their content and check compliance with them. The information required by the ownership function relates to the efficiency of performances.

In information systems, however, information requirements are not formulated so clearly for each function, nor do they emerge in such a complete form as this classification suggests. For example, the central information system overlaps to a great extent the branch statistics looking at the same object from different managerial levels; or several parts of socio-demographic or environment information systems have important sayings and influence for economic policy, e.g. employment, education, depletion of natural resources. In a simplified formulation it can be said that the EIS covers all statistical, book-keepings, programming, planning and forecasting information related to flows and stocks of the real and financial aspects of production, distribution and consumption of goods and services.

2. MAIN CHARACTERISTIC FEATURES OF EIS

2.1. Information for planning

Planned actions and goals are characteristic not only of individual human beings but also of large organisations, and increasingly so in a historical perspective. Institutions, governments and socio-economic organisations bear testimony to the fact that the significance of planned actions and goals is going to become more and more important to mankind. It is striking to see how many fields transform intuitive and diffuse planned work into well organised and formalised planned work. Historically, this holds true for the planned economies, in particular.

This situation is of determining importance for EIS: one of their basic tasks is to supply data aiming at the elaboration of national plans and the follow-up of the implementation of plans. The information supply and services to support the planned development, operation and management of national economies must cater to the following main categories of requirements:

(a) those resulting from the scope and nature of the planned spheres and processes;

(b) those related to different types of plans and background documents;

(c) those related to the method and working programmes of the plans and their supporting documentation;

(d) those related to the implementation of plans and the control of implementors; and

(e) those required by the planned functioning and management of the economy.

At an earlier stage, the question was raised in a simple way: What data or information are needed about the economy for planning purposes? Today, however, those responsible for supplying information start essentially with the following questions: What is the nature of socio-economic phenomena to be planned and managed? How do they change? Which areas should be directly and/or indirectly planned? What is the necessary scope and depth of analyses? What kind of picture, model, forecast, or plan is adequate, and what kind of information and data are needed for their construction?

In order to develop stepwise a practice based on such elaborated questions, the countries followed strategies for the design and implementation of EIS, which lay emphasis on planned operation, adaptation and development of the national economy, with special regard to its concrete realities, and differentiating also according to professional, supervisory or official licences and scopes of duties derived from such realities and starting from them is defined what kind of basic and processed informatin is required by planners and different decision-makers. Consequently, this strategy does not enable the narrow professional approach of information theory and technics to become dominant where attention is mainly paid to the occuring works and products of information processing, thinking in the framework of the full process over from data sources and basic data to their final users and products.

In the implementation of such planning-oriented approaches for EIS the Central Statistical Offices closely interact with ministries, first of all, with State Planning Committes in all countries. For example: the Central Statistical Board of the USSR co-ordinates with Gosplan all statistical programmes. In its turn, Gosplan works out an improved organisation and methodology of planning, and presents them to the Central Statistical Board for co-ordination. These combined measures ensure the rational ways of solving economic problems, the co-ordination of the reporting and planning indicators, and enhance the further development of state planning and statistics. Similar co-operations are characteristic practically in all centrally planned economies, although there may be considerable differences in scope, nature, frequency and concreteness (detail) of indicators and methods to be agreed.

Therefore, the tasks of the central statistical offices in planned economies - compared to those of market economies - is to a great extent broader, because their tasks have to include establishing statistical bases connected with plan-measuring, producing information necessary to it. In addition, in the past in all countries and still today in many countries the central (national) plan is distributed and addressed to individual enterprises and other actors of the economy, therefore a full scale observation of economic performances dominates, while representative censuses are of minor importance.

2.2. High integration of EIS

Centralisation constitutes a principle of paramount importance for the organization of the statistical service in planned economies. Creation of a single (unified) centralised system of state statistical bodies appeared to be an efficient way of ensuring the implementation of the principal objectives facing statistics in the planned economies.

With the central headquarters (bureau) of statistical services, in most countries, are organically connected the regional organs of the bureau which carry out, in the given areas, the collection and checking of statistical data for central purposes on the one hand and provide information for the local authories, on the other hand. The organizational structure of the headquarters significantly depends on the extent, organisation and tasks of the regional apparatus, including the level of computers it is equipped with.

The automatic data processing - usually an independent organizational unit in most countries - is also built in the structure of statistical offices, together with related organizational, co-ordinating functions and methodological units, and it is decisive, to some degree, for a part of internal labour division in the office.

Centralisation also means that the state statistical bodies are entrusted with the task of pursuing a unified policy regarding statistical methodology, collection and processing of information, and the main methodological approaches towards its analysis. In Hungary, for instance, an important co-ordinating authority is the inter-departmental Statistical Co-ordination Committee consisting of the representatives of interested state organs (entitled to licence data collection). This Committee operating as an advisory body to the president of the CSO takes up common attitude on its sessions in fundamental professional and methodological issues concerning the statistical system. The Committee has permanent working groups (e.g. the Conceptual Working Party) and establishes from time to time ad hoc expert groups aimed at finding the solutions to concrete tasks as needed.

Centralisation of statistics, in particular, means that all the enterprises and organisations in the country submit data (reports) to the statistical bodies of their respective areas, and those bodies process them and later despatch the summarized data to all the interested bodies, including ministries and government agencies, according to the practice of the Central Statistical Board of the USSR, Hungary and other countries.

2.3. Role of national accounts in integration of economic statistics

Thanks to the integration of economic statistics with the system of national accounts, current statistics are built on a relatively sound basis and harmonized with each other in planned economies, more or less in the same way as SNA (1) does in market economies. In the planned economies, the national accounting system is known as the "System of Balances of the National Economy" (2), or, in United Nations terminology, the *Material Product System* (MPS). The main conceptual difference between MPS and SNA is that in MPS, the production concept is limited to the sphere of "material production" namely to producing (i) goods, and (ii) services related to the production, repair, transportation and distribution of goods (usually referred to as material services). In some countries, passenger transport and communication are also included in the material sphere for practical reasons.

The revised and extended version of MPS (3) makes it more comparable than its previous version with SNA, due to a number of new areas included in the system. For example, the indicators of the incomes and expenditures of the population which contain the total income and the total consumption of the population; the balance of non-material services provides the data needed for conversion of MPS concepts into SNA concepts and vice-versa. The revised system also approaches a kind of dual sectoring; in contrast to the previous sectoring activities based exclusively on kind of activity units. In addition, the way in which the revised system treats financial flows makes the analysis in terms of institutional units possible.

In promoting the reconciliation of the two systems successful bilateral studies by France and Hungary, as well as Bulgaria and Finland were arranged under the aegis of the Conference of European Statisticians. The participation of Hungary was enabled by the specific feature of its accounting system developed in the late sixties; while the core of this system corresponds to the basic principles of the MPS, there are several extensions and new dimensions in it. One extension concerns the non-material sphere, thus allowing for the compilation of indicators covering all economic activities. For checking the conceptual relationships between SNA and MPS, the main national accounting aggregates of Hungary were numerically converted into the SNA aggregates and those of France into the MPS.

Also, Bulgaria and Finland carried out a bilateral comparison and a verification of the conceptual links between MPS and SNA. The work was in many aspects similar to the France-Hungary exercise and relied on the experiences obtained in that work. But the Bulgaria-Finland comparison also developed and used a number of methods which differed from those adopted in the previous comparison.

Both exercises provided valuable experience in bridging SNA and MPS aggregates.

The aim of the conceptual and practical works on intersystem comparison is a regular compilation of comparable national accounting figures for the market and planned economies, however, it also facilitates the comparability of economic statistics in any branch and areas.

3. SYSTEM OF DATA COLLECTION, PRODUCTION AND DISSEMINATION

3.1. Data collection

In comparing the basic data supply with that of countries with market economies, three main features must be mentioned. First, a substantially larger part of basic data is supplied in planned economies by full scale enquiries, while censuses play a relatively smaller role, at least for economic statistics. Secondly, the importance of exhaustive surveys in planned economies is considerably greater, while that of sample surveys is lower. Third, business (enterprise) accounting (bookkeeping) practice is centrally co-ordinated and provides a sound basis for the supply of statistical data.

The bulk of the basic information required for enterprises, co-operatives and institutions is provided by obligatory current returns, mostly on a monthly, quarterly or annual basis, which is most helpful in ensuring coverage.

In line with their growing importance of private sector in planned economies they also have increasing obligations to report statistical data. However, the frequency of these observations is remarkably less, and sampling methods have greater importance.

Another basic source of information is the population census, generally carried out once in a decade (mostly the beginning of the decade). Other inquires about households are based on voluntary data supply. Family-budget surveys have an outstanding role in all centrally planned economies, providing continuous information on income and expenditure of several thousand households. Also, there are some ad hoc household inquires, generally refereed to as microcensuses which provide information on consumer behaviour, employment, time-budget, and other economic aspects of life.

The interest lately increased in the use of administrative records (registers) for statistical purposes in all planned economies. It gives motives for surveying, in detail, experiences related to them.

The multi-purpose use of registers is greatly justified by the following advantages :

- cost decreasing as they make use of data for several purposes;
- data-supplier is released from the obligation by means of which labour-force is saved;
- continuous direction of registers is ensured by means of which labour-force is saved;
- observation units of registers are the economic units or/and individuals, therefore making use of individual data in relatively large numbers which are simply available for statistical purposes carries in itself the possibility of a deeper and a more detailed analysing activity. At the same time, the data so acquired can be aggregated for region, sector and many other criteria.

However, the realisation in practice of attainable advantages, that is making use of the full range of registers for statistical purposes is hampered by a lot of circumstances:

- during their realisation it is not a crucial point to comply them with statistical purposes;
- in forming them, in general, there is no purpose of primary importance to bring them in harmony with other - for example statistical - systems as to their content, concepts and classification;
- the purpose of them, generally, is not to store the old data, to make them comparable and accessible;
- the register data of public administration are not necessarily available in due time required by statistics.

The experiences of the Central Statistical Office of Hungary - similarly with the experiences of other planned economies - prove that data of registers can be fully utilized in the case when, in the course of establishing register systems, the statistical aspects play an equal role with the purposes of administration, management and decision-making. From the viewpoint of utilization of registers for statistical purposes, they can be classified into the following groups :

(a) The register system satisfies the requirements of statistical needs. For example:

- register of foreign trade statistics
- register of balance sheets and income statements made by enterprises

- population register, which can be used for nominating data suppliers in the social and demographic statistics on the one hand, and its structure integrated with the statistics of demographical changes, on the other hand.

(b) The statistical system relies on registers, first of all, as on a list (nomenclature) of determined units, but parallel with it, it is also possible to derive statistical data from the register. Such are for example:

- registers of economic organisations which is an indispensable precondition of uniformed economic statistics;

- register of regional units of the public administration (counties, villages) which is used by all branches of statistics.

The utilisation of registers for statistical purposes described above is a good example of the effective co-operation between the various government authorities and it is desirable to involve more and more registers in these groups.

(c) The third group of registers is composed of those, during the establishment of which the statistical purposes where not taken into account, but due to their great number of useful economic information, their utilisation cannot be disregarded by statistics. Such are certain fiscal registers e.g. those on private persons as taxpayers and those on organisations financed by state budget. These data are also regularly transmitted to Central Statistical Offices on magnetic tapes, but their utilisation gives much trouble because of different conceptual aspects of data and techniques of processing. The solving of these problems is evidently based upon a tighter co-operation and the enforcement of statistical aspects.

(d) A fourth group of registers (registration by telephone subscribers, pensioners and pension payments etc.) is characterised by the fact that only certain aggregates, total sums of them can be used by statistics. In the case of the majority of registers pertaining to this group, it is possible to take over the elementary data as well for processing them according to the requirement of statistics. Though in the course of the systematic statistical work their utilisation has not been seriously considered so far, it would be reasonable to take this opportunity to analyse certain fields of subjects more deeply.

(e) A relatively great number of registers is known (e.g. information systems of technical and legal nature) and the use of which is actually considered as unsuitable for statistical purposes. The reasons of the mentioned fact can be mainly attributed to the present form of registers, the degree of their perfection, the data supplying of non-full-range character and conceptual inadequacies.

Based on experience gained, it can be stated that in the field of statistical utilisation of different registers - despite the mentioned difficulties and barriers - there are additional possiblities in the planned economies.

3.2. Data production

The first stage of processing is carried out by the primary collectors of the data, i.e. by the local organs of CSOs, or by the ministries and local statistical organs. The principal aim is to obtain sub-totals but it is also the first step in the compilation of national totals.

The next and perhaps the most important stage of processing takes place at the Central Statistical Offices. The results are the various national totals, averages, quantity and price indices, etc.

For certain purposes, these processed figures are the statistical end products. For others, however, further processing may be needed. This is generally carried out by various research institutions. The rules of processing (e.g. what kind of index formula is to be used) are generally standardised. International recommendations are largely taken into account.

Over the last two decades rapid computerisation has taken place. At present not only the Central Statistical Offices, but a number of ministries and other governmental organs possess large computers. However, in conformity with the level of the economic development of countries, in the region, in general, and in some countries, in particular, it is a great trouble that the most modern data processing appliances are missing and often the greater information centers are only equipped satisfactorily. Therefore the proportion of manual work is data processing is still great.

3.3. Data Dissemination

Over the past two decades, there were two main tendencies in data dissemination :

(a) Through functions supporting planning and decision-making in planned economies, the range of socio-economic analyses and forecasts prepared for planners (decision-makers) has increased and the number of qualified (secret) publications has diminished. This is also linked to the fact that there are operating research institutes or units dealing with research in several Central Statistical Offices. For example, in the Czechoslovakian Office two specialised institutions are in operation: the Institute for Public Opinion Researches and the Socio-Economic Information Research Institute. In almost all other countries there are such or similar institutions.

(b) The majority of information has been released in printed publications till now, however the proportion and importance of information in form of "queries" has increased e.g. in Hungary, the CSO and the State Office for Technical Development (the national office co-ordinating technical development activities in Hungary) elaborated in common a concept for establishing a closed TELEDATA system serving the information supply of the top-level leaders of government organs. In this system the users are able to access the most important and most actual statistical data. In addition, more relevant information (e.g. exchange rates, weather forecasts) is provided through the TELEDATA terminals. The development of the system and the future editorial work would be carried out with the participation of all the most important governmental information sources, such as : the Hungarian News Service, the Ministry of Finance, the Ministry of Foreign Affairs, the Ministry of Foreign Trade and the National Bank of Hungary. Data transfer possibilities are provided by the Hungarian Post; the central computer of the system is operated by the CSO Computer Center. The development of TELEDATA system, in the first phase, was started in the CSO by establishing an experimental system of limited volume at the end of 1985. The realization of the entire concept began in 1987 when adequate experience was already available.

3.4. Co-operation between producers and users of EIS

The system of data collection, processing and publication in planned economics cannot be treated and developed independently from each other. Instead, these systems must be connected horizontally and vertically.

Instead of systems serving the purposes of one single scope of users, the emphasis should be laid on multipurpose developments facilitating the multiple use of wealth materialized in data. This objective demands the fullest possible consideration of partners' demands on any part of EIS. Such a solution should be promoted also by legal and administrative measures, further by "joint ventures" supported by initiatives of the issues concerned. To this end, the mutual accessibility of information systems must be provided.

The wide-scale application of computer devices opened new possibilities in the technical relations existing between CSOs and other EIS. The data flow on magnetic tapes is ranked into the first place regarding both its volume and significance. E.G., in 1985 the Hungarian CSO realized about 300 data transfers via magnetic tapes to other information systems for further processing in Hungary. The most important user is the National Planning Office, the planning activities of which are based fundamentally on data received from the CSO on magnetic tapes. The transfer of data on magnetic tapes is of great volume towards other government organs, as well. By co-operating with the competent ministries, the CSO regularly exchanges statistical data dealing with industry, building and construction and agriculture. The CSO receives significant financial data files on magnetic tapes (balance sheet reports of enterprises, taxation data of enterprises, other organs and private persons etc.); further the entire foreign trade statistics from the Ministry of Foreign Trade; data flow realized on magnetic tapes interconnects the population registration and the system of vital statistics.

However lafge the volume of data flow on magnetic tapes between government information systems is, it offers no possibility for the operative satisfaction of individual user's demands. To meet such demands, government organs have gradually developed their on-line statistical data bases for their own, internal use as a first step in this direction. Accordingly, the content of data bases is in harmony with the scope of responsibility of the government organ in question. The on-line statistical data base of the CSO, for example, makes accessible wide scope of economic statistical indicators today, while the data base of the Ministry of Finance comprises primarily financial data of the balance sheet reports of enterprises. As it logically ensues from the co-operation between producers and users of government information systems, simultaneously with the creation of technical preconditions the location of terminals to the partner organisations has been initiated through which the said data bases can be queried also by external users who, of course, have a licence to it.

A more developed solution to the technical links of information systems is to establish a network which connects the computers in question. In this field, the Eastern European countries with planned economies are still in the phase of designing and preparatory work. In Hungary, for example, the first network will comprise the computers of the CSO center and those of the CSO's regional - county - organs. Via this network the edited data derived from data collections will be transferred to the CSO center, and through this network the data files, first of all the statistical data base stored in the centre will become accessible for each regional organ. The designing works of the netowrk of the most important government computer centers - being already today in close co-operation with each other as stated in the foregoing - are already in progress. According to the expectations, the data flow based today on magnetic tapes could be sped up through this network and data bases would become mutually accessible. As per the studies conducted so far, the linking of computers of the CSO, of the National Planning Office and of the Ministry of Finance is justified by existing demands, as the first step in this respect. But taking into account the differing hardware - and software environment of the individual computer centrers, further to the mass volume of data to be transferred, to data security problems, the development of this network is extremely time and cost-consuming.

3.5. The use of mini and microcomputers as integrated parts of data processing systems

The experience in the use of microcomputers in statistical offies and ministries is positive and one may expect further substantial expansion. Many problems appear in the use of microcomputers, as a consequence of rapid hardware development while the development of software, documentation and other services lags behind, if compared with the large computers.

In the planned economies, the application of small computers started in the early 1970s. They are installed in regional centres and, besides data entry, they also serve for the transmission of data files to computing centres for central data processing. One of the objectives of the network is to extend the computerisation of statistical data processing to the level of regional and district bodies of the state statistics. Small computers are used for:

- local data processing for the information needs of the statistical bodies;
- interactive entry and validation of primary data;
- transmission of data files to and from host computers;
- direct access to data bases in host computers;
- maintenance of specialised data bases; and
- other tasks, such as office applications.

The central statistical bodies and ministries also reckon with the distribution of certain activities, particularly those concerning statistical analyses, modelling, preparation of publications, etc.

The use of small computers in various departments appears purposeful if it is done in such a way that the employees of these departments themselves may provide selected types of processing as well as the access to large data bases of the mainframe by means of terminal emulators.

The spread of small computers and their linking to other computer systems will contribute to the successive integration of automated information systems of the state management in planned economies.

4. MAIN TRENDS OF MODERNISATION OF THE EIS

4.1. Rationalisation of the EIS

Data collection, processing and analysis of data involve significant expenses both for data-suppliers and the state budget. Therefore the central and the sectoral EIS undertake the task not only to give a true picture of the socio-economic development, but to realise all this at the lowest possible costs. Therefore, the statistical offices and ministries revise regularly - in general every year - and harmonise the operating EIS, their extent, contents and their co-ordinated state. However, apart from the annual revisions, from time to time, comprehensive and complex modernisations are carried out, as well. In the recent years such modernisations were performed, e.g. in the USSR and in Hungary. In 1987, in Hungary different committees (by the aid of 500 experts) realised simplifications through :

- eliminating unjustified parallelism;
- reducing frequency of data collections;
- stopping data collections completely or partially;
- reducing groups of data suppliers (e.g. change-over from the full data collection to the representative observation).

During the modernisation works, more than 450 obligatory data collections of central statistics and about 1000 more gathered by the ministries (central authorities) were revised. The work has resulted in significantly simplified central state statistics in the fields of the investment, construction, housing and retail trade in particular. In 1988, 41 questionnaires will be annulled, the number of periodically distributed ones will be 11 less than in the last year, 160 questionnaires will be modified; all of these changes will reduce the number of required data by about 20%. It is also an important derived result that a greater attention was paid to the costs of information than in earlier years. It can be expected that the usefulness of information, the extent of their application, the circle of data suppliers, deadlines and required accuracy will be more seriously considered in the future.

4.2. Necessary changes due to reforms of the economic management systems

The accelerated reforms of economic management in the planned economies need new information and a great number of organisational changes. A modernisation trend is definitely reflected e.g. by the fact, that the Central Committee of the Communist Party of the Soviet Union and the Council of Ministers of the Soviet Union in June 1987 decided to attain radical improvements in the national statistics. Their decisions initiated - among others - the following trends of changes:

- immediate progress should be made in the field of providing quality indicators (e.g. indicators reflecting the technical progress and the socio-political results);
- work of enterprises should be evaluated by the statistics in a new approach, started from the conditions of the full economic self-financing;
- circle of families involved in the household budget survey should be considerably enlarged, and representativeness of conditions should be ensured, to a greater extent, according to economic districts, branches of national economy and social groups;
- statistical information should be considerably extended.

In Hungary, the EIS, the extent of data collection and its structure, the content of essential indicators, the methodology of data processing and analyses, features and forms of information work are actually influenced, to a great extent, by the value added tax and personal income tax introduced at the beginning of 1988. The first experiences prove that burdens inherent in information work are significantly increased by this tax reform. Consequently, cuts implemented last year in the field of data collection were especially timely for this reason as well.

4.3. Increasing needs for international comparisons

In connection with the EIS of the countries with planned economy can often be heard the judgement according to which no appropriate attention is paid, in their development, to assert claims relating to the the international comparisons, and they do not allow the carrying out of regular scientific examinations of the world economy and the study of the processes of the economic management emphasized in external countries.

In order to contribute to the international comparisons the number of the countries increases which introduce into the practice of their economic calculations the indicator of gross domestic product (GDP) counted on the basis of the methodology of the United Nations. Apart from the indicators now used relating to the national income, Poland and the USSR - following the practice introduced by Hungary - have started to apply, from the beginning of 1988, the GDP-indicator, and they intend to publish them. In other countries there are also efforts to publish data being more suitable for a broader international comparison. This principle ensures to increase the authenticity, accuracy and usefulness of data. It is also worth mentioning that the countries with planned economy express great interest in the International Comparison Project (ICP) organised by the UN, which makes the comparison between the GDP per capita in a common currency possible as well.

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CRITICAL REVIEW OF ECONOMIC INFORMATION SYSTEMS

THE OVERALL PROGRAMME AND CONSTRUCTION OF CHINA INTERNATIONAL ECONOMIC INFORMATION CENTRE

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1. BRIEF REVIEW

The China International Economic Information Centre (CIEIC) was established by a special group formed by the Ministry of Foreign Economic Relations and Trade in 1983 under the instruction of the State Council of the People's Republic of China at the time when China's economic construction had achieved great progress and profound changes had taken place in China, and had turned China towards a new outlook ever since the third Plenary Session of the 11th National Congress of the Communist Party of China. All these are owed to the firm adoption of the overall reforms and to the policy of opening to the outside world. Under such circumstances, the actual and potential demand for information, especially for economic information has become an increasing need. As a matter of fact, neglect of economic information has been a problem for China's single planned economy and the closed door policy in the past. To compare with the information cause in China's science and technology area it clearly shows how serious this problem really is now. Work on the complete system of science and technology information began in 1956. After 30 years, it has a contingent of more than 100,000 professionals. Information institutions at national, provincial and grass-root levels, enterprises, designing institutes and colleges all over the country with a certain scale of considerable accumulation of documentary materials and with other information resources in various forms of documentation retrieval system and an information dissemination system has been set up. In a striking contrast, work in the international economic information area was quite difficult. There is not even a unified information management organization; not a prompt and sensitive nation-wide information system. There were few active and well-qualified specialists ; information scope was too limited; technical means were backward; transmission and utilization capability was low and its economic and social efficiency was extremely poor. This kind of state is certainly far from suitable for the development of foreign trade and economy in China, not to speak of the gap with developed countries. We spent nearly one year on studying economic information systems and institutions at home and abroad and looking preliminarily into the domestic end-users' needs for international economic information. We drafted by means of system engineering the first overall plan of CIEIC, advancing its nature, task, functions and the organizational structure. In this plan there are ten divisions, 80 functioning units, each unit with its own scale, amount of information, business scope and suitable technology to be applied. The building space covers an area of 20,000 square metres. This plan underwent several discussions and amendments. We have invited some information specialists from the United Nations organizations and scores of Chinese specialists in information, technology and architecture for their advice. We consulted documentary materials of nearly 2,000,000 words, visited 40 units at home and abroad, attended near 100 meetings and seminars. Eleven domestic information specialists were required for consultancy on specific subjects.

Suggestions from 9 foreign specialists were seriously taken up. This program and the report based on this program was approved by the State Council in June, 1985 and the MOFERT was authorized to establish CIEIC as a national level institution. At the same time, the CIEIC building construction plan also won the approval of the State Council.

2. NATURE AND TASKS OF CIEIC

Internationally, the concept of "Information Centre" was a product of 1960s. According to materials we gathered, it was first used in a report by U.S. President's Science Advisory Committee in 1963. Differing from that of other information research institutions, this concept stressed the initiality and creativity of information services. It actually puts forward the dual nature of information: research and service. UNESCO once pointed out that information centres should have three functions:

1) to search for all available information materials for a specific research purpose;

2) to analyse and evaluate the information gathered;

3) to condense and store information in the forms of papers, tables or synthesis and to disseminate the processed information through current bulletins, publications, consultancy, etc.

Let us look at another specialist's exposition: Those specialists who can search for materials in need, analyse them and provide key information for research work could be more helpful than those who are burdened with documentary materials. The professional intermediates (they are engaged in research work themselves) are the mainstay of an information centre. They have made the information centre a research institute and a professional library as well. The sign of a qualified information centre is whether it has some distinguished scientists and engineers working for it. With the increasing number of professional information centres, a good many information specialists will be needed. They should be painstaking and professional, able to explain and absorb the essence of information and provide others with the information for their research work in this area.

Thus it can be seen that the information centre is a new type of organization developed lately on the basis of traditional information institutions. It gives prominence to the functions of analysis, evaluation and research, takes its professional information specialists as the quality standard. Meanwhile it is firmly established on the early information practices and research methodologies of those related specialists. To meet the above needs, an information centre should be based on professional libraries or information institutions and should possess high quality storage and retrieval systems.

In view of the actual conditions in China, the set-ups of information centers and information institutions have all been taken into consideration in the overall plan. As a matter of fact, we are burdened with double tasks: to build up a system of traditional international economic information service and to lose no time to speed up the establishment of a centre that could provide concentrated and valuable information. Our information centre's tasks, as speculated by the State Council, are to be responsible for collecting, analysing, storing international economic information and providing the central and local leading bodies,and other relevant departments with up-to-date economic information, serving China's foreign economic relations and trade, management, decision-making, production and scientific research.

To avoid losing track, the research nature of the information centre should be different from the vocational research of information centres which should aim at processing and disseminating the information. They should not only be fully qualified professionally as those working in the research institutions, but also could undertake serious information service work, to provide information for policy-makers, researchers and enterprises dealing with businesses.

3. PROPER HANDLING OF THE RELATIONS BETWEEN COMPUTERIZED AND NON-COMPUTERIZED INFORMATION SYSTEMS

This is a theoretical as well as a principle issue in CIEIC's programme. According to our superficial understanding, most of the international economic information is disseminated by traditional means of printed matter. Furthermore there are also micro-materials. The computerized information, namely data base products (including on-line and off-line products) is of great importance in macro-economic statistics. Yet, generally speaking, they could not replace most of the printed matters, especially in micro-economy. It is neither possible nor necessary for most of the business information needed by the enterprises to be computerized. Judging from some forecast materials, the turnover of traditional information products is still higher than that of the data base products even in developed countries. Printed matter will still be increasing annually by about 10%. The reasons we think are as follows:

1) In view of the status of practical technology used in computers, the whole process of information handling at the present stage could be deemed as semi-automated except the parts of computation and data output automated which may be counted as fully automated. The pre-processing in most parts is now done manually. Collection, processing and entry of data for the data base are mostly input by hand.

In the final analysis, the data base is established on manual-system bases. Owing to the needs of data processing and additional voluminous efforts needed for the realization of standarization, the work force needs within a certain period of time to be supplemented instead of being somewhat reduced. Such a situation would change so long as the computers could be improved to such a level that they will be able to recognize handwriting and have the function of automatic self-processing of data of any kind such as word retrieving or abstract compilation, etc.

2) There are only a few Data Bases of full text type. Most of the data bases can only provide catalogues, leads and data. The users have to find support from relevant original printed matters, microfiches or more detailed information to do their work well and have a broader outlook.

3) As a result in the limitation of the screen display and availability of computers, it is certainly impossible to be adopted as an ideal tool to replace newspapers, and offer printed matter as audio-visual material which is more convenient, economical and colourful.

4) In providing services data base products to customers, special environments and sites are needed, in addition to papers or other means. Moreover, a team of professional experts familar with contents of data base and retrieval strategy must be composed to support its users.

5) The system design of data base needs a quantitative description of data information concerning data resources, process of handling, and particularly, the customers' demands, which are accumulated at its initial step through practice of the systematic manual work.

From microanalysis, the development of information system, [and even the concepts of data, information, system, etc.] has reached its new meaning following the development of computer techniques. However, information system does not mean computer system because the build-up of the information system is aimed at information, whereas the computer is a kind of technical method. The information system has existed since ancient times. Some experts even proved that animals and plants also have their own information means. Usually computerized information systems are called automatic information systems, whereas non-computerized information is called manual or traditional information system.

In fact, automatic information system is named in a relative way. No matter how automatic it may be, the modern economic information system in the final analysis can only be the man-machine system. Thus while planning the whole system according to the means of systems science, the boundary of the system should not be drawn between man and computer and only the configuration of hardware and software is taken into consideration. The boundary should be a link joining the man-computer system to the society. The data resources, information services and other links should be regarded as part of the system. The interior flow, procedure, and inter-relations of the system should be integrally considered in case the information flow is blocked up or bottlenecked, and the function of the whole system will be consequently limited or choked at the thin neck of the "flask". The computer is only a means in the link of processing. The overall plan should also take into consideration the processing of quantities of information which are not put into computers and the inter-relations between computer and processing themselves. Generally speaking, the whole system exists in society. Thus the effects of the social environment and condition should be taken into account. Therefore we cannot ignore the condition of our country. Even if we could find the money to buy the 1980's advanced technical equipment to process information and gather qualified technical personnel to have the equipment running, the present decisive factor of data resources and information services, the two links at both ends, can not accordingly be changed such as the coverage, the accurate degree and the collection of the basic data resources; the formation and increase of social information awareness; the degree of demand for information; the degree of scientific decision-making at various levels; information socialization, commercialization and its value as well as social and economic results, etc. All these social factors and conditions can only be improved progressively with the development of national economy. For the above-mentioned reasons, in the mapping out of the plan, we abide by the principle that we lay stress on both computerized and non-computerized systems. Among the 10 divisions, the staff members in the computing division just make up about 1/10 of the total. We will insist on this principle in the development of our business in future. In a word, a few 1980's advanced technology introduced from abroad and the social environment at the initial stage of socialism will both exist simultaneously in China.

The manual and automatic information means will exist for a long time, and they will rely on each other, help progress and intertwine. While setting up the information system, a proper and correct estimation of the position and function of the computer necessary to improve the development of computer application.

4. ACTIVELY DEVELOPING BUSINESS AND CAREFULLY KEEPING THE BUSINESS ORIENTATION.

In the development of business, trying to expand international economic and trade information resources to serve China's foreign economic relations and trade, management, decision-making, production and scientific research is the orientation of CIEIC.

CIEIC has made efforts to work on the development and research of international economic information resources, has established business relations with many major international information organizations, some of them have appointed CIEIC as their network nodes, depository library or focal points in China. CIEIC has also become China Jute Information Centre of U.N. Asia-Pacific Jute Information Network. It has access to some authoritative data on world economy, finance, trade, investment, technology transfer, etc., and it has established a data base of Chinese front-line products, and is building the data bases of trade protectionism and the directory of Chinese industrial and commercial enterprises.

CIEIC has built up business contacts with economic and trade information organizations information data corporations in more than 20 countries and territories, and has ties with many commercial offices of foreign embassies and foreign trade representative offices in China and industrial and commercial circles abroad. It handles the export and cooperation opportunity information received from China's economic and trade organizations abroad and has developed the information sources of target markets, technology, investment, trade and cooperation opportunities, laws and regulations, directories of enterprises, etc. CIEIC offers its services mainly through the following methods:

1) Publishing International Economic Information (in Chinese) and International Economic Information in Brief (in Chinese) as well as China Economic and Trade Information (in English). All these periodicals are welcomed by Chinese and foreign readers from whom CIEIC gets quantities of information feedback.

2) Making a special TV program "Showcase of the World Economy" on CCTV designed to introduce the collected or self-produced video tapes of foreign markets, products and technology to the Chinese audience;

3) Delivering information cards regularly to the users and providing SDI services to them according to their separate needs and lines;

4) Receiving visitors and users throughout the country answering their enquiries, helping to conduct business contacts and holding information exchange conferences and other activities with domestic or overseas organizations such as Sino-Yugoslavian Trade and Cooperations Symposium, China-Hong Kong Cooperation Symposium and China-Europe Economic and Technological Information Exchange Seminar, etc.;

5) Having increased 163 kinds of newspapers and serial publications through exchanges and subscriptions, which have enlarged the storage of documentation in MOFERT.

Up to now CIEIC has offered a certain amount of information project services to home users, among which over 700 items are information on export, introduction of advanced technology and equipment, joint ventures, contracting opportunities, and development of new products and technology.

According to the tasks stipulated by the State Council and the MOFERT, our services are for:

1) Foreign economic relations and trade: it includes economic and trade departments and affiliated organizations, trade corporations under industrial ministries, open coastal cities and part of the inland.

2) Management and decision-making: it covers MOFERT, other relevant ministries and commissions, as well as provincial and municipal leading organizations.

3) Production: it includes industrial and agricultural departments, the small and medium-sized enterprises in particular.

4) Scientific research institutions.

Our services are aimed at linking information to the development of Chinese open policy and the foreign economic relations and trade. When doing these, we take the promotion of exports and earning foreign currency as the main objects, and we then try to strengthen the combination between foreign trade and the improvement of production and technology.

CIEIC has established close information relations with many domestic economic and trade organizations, relevant ministries and commissions, coastal areas, some inland provinces and many enterprises. Now it is working on the establishment of an information network in China

In the development of our economic and trade information services, we find part of our services are connected with trade operations themselves. We have put in some people for such services and tried to play the role of a bridge to promote this kind of cooperation. However, experience has proved that CIEIC is not an economic entity, it should not be involved in such concrete trade activities, nor should it be on behalf of the benefit of any part and it is unable to undertake the risks of any party. What it should do is to offer information and consultancy to its users with equal chances. As to the recovery of cost, the services should be payable, but it is not a profit-making institution as similiar international organizations. It should take the social benefits as its main aim and it is for saving the nation's expenditure that CIEIC charges for its services.

Through two and a half years practice, we have realized that whether CIEIC can be well developed depends on the quality of its staff. Information business has the features of a specialized profession, a coverage of wide sphere, and a combination of theory and practice. Only competent professionals can offer the qualified services. Thus we have worked out a plan to train our staff to be proficient in profession, with a proportion of senior professionals. Training staff is a strategic step in the development of CIEIC. The plan also includes setting up a training system in CIEIC, which has been approved to be an exemplary project supported by UNDP.

This project covers the necessary facilities, hardware and software, lectures given by experts, and staff training. The project is expected to be completed in early 1990 with the support of the Chinese government and UNDP. It will be taken as part of the building of Information Centre.

CIEIC has been established at the time when reforms are going ahead and the policy of opening to the outside world is being implemented in China. There is much for us to research and develop. With the spirit of pioneering a cause through arduous efforts, CIEIC will try to quicken its pace to undertake the tasks entrusted by our country.

ON THE INFORMATION SYSTEM OF NATIONAL PLANNING IN HUNGARY

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INTRODUCTION

Nowadays, modernisation of the national economic planning is qualified as a task of outstanding importance for the National Planning Office. Modernisation can be conceived as a reaction to the changes in external conditions, in the economic management, to shifts in the economic situation and experiences accumulated in planning. The process of modernisation has an effect on the scope of planning, the systems of functions, divisions of labour and responsibilities in planning, and evidently on the content and the technology of planning as well.

The paper outlines the information supply of planning and development works necessary in the field. The problems of statistics does not belong to the subject of the paper, our attention is focused on the features of planning. The paper gives a survey of:

- the system of supplying planning with data facts;
- the information system formed in the process of planning work;
- the planning models built on the information bases;
- the hardware and software background of information - processing and modelling activities.

In the framework of the planning practice, two major types of information are used:

- the first group covers the data facts of development in the periods preceeding the plan year
- the second one embraces calculated and planned information produced in the process of planning, concerning forecasts and targets of the development of economico-social processes.

Methods for producing, processing and utilising in planning of both major types of information differ from each other in many respects. The essential task is to decide on activities and methods of organising the system which provides data facts for planning. Relying on this system, the system of data produced in the process of planning should be elaborated.

1. INFORMATION SYSTEMS OF THE PLANNING OF THE NATIONAL ECONOMY

1.1. Systems for providing data facts

The supplying of data facts to the planning of the national economy is mainly ensured by state systems of data collection (state statistics, financial balance reports of economic units and organisations financed by state budget, information services of banks and of other financial organs). The National Planning Office does not order data collections nor does it only in very exceptional cases. Data made available by the central authorities responsible for providing data facts can be obtained and used by the planners in different forms: the individual statistical publications, forms containing the original data, and computer data media which are used in our days more and more widely. A particular emphasis is laid on the on-line information systems making the direct data query of information resources possible.

With the appearance of computer data media, a qualitative change has taken place in the supply of planning with information. Making use of media ensuring the availability of original data, the user can always process information in conformity with his/her special intentions (in a grouped, aggregated or interrelated manner).

The main features of information systems used in the Hungarian planning practice can be summarised as follows :

a) The overwhelming majority of data facts necessary for planning work are provided on computer data media by central authorities or institutions carrying out data collections. Organisation of information supply makes a close coordination between the Planning Office and the other authorities necessary. Consequently, system developments with the purpose of planning should be adjusted to computing plans of institutions responsible for data collection. This adjustment, at the same time, should not mean passivity; if in some fields it seems to be necessary, the change of computing plans can be initiated.

b) Preparation of applying data facts available in different fields begins by selecting indicators to be taken over. This work of selection is facilitated by the fact that the main partners have already supported their services by well-documented register (catalogue) systems. In the phase of selection the actual tasks and the methodology of planning and the main trends of development work are considered decisive. One part of data facts taken over is aggregated in conformity with the methodology of the planning of national economy, the other part consists of original enterprise or product series data.

c) Taking over of data facts should meet two kinds of conditions

- as a planner's order individually specified, on the one hand; and
- on the other hand as a result of methodological development, based on the preliminary determination of planners' supposed claims, or planners' expected future demands generated by development itself.

d) Time necessary to meet demands has two kinds as well:

- tasks to be performed with short deadline are frequent, but
- there are planners' claims requiring longer preparatory work and the solving of system developing problems, as well.

The former tasks have to be accomplished as far as possible by easily parameterable and adaptable processing methods or by on-line systems enabling the direct data query, and the latter ones by any other means corresponding to the purpose. Taking the tendancies of development into account, attention should also be paid to the fact that demands are gradually shifted to the advantage of the first group, therefore need for means ensuring data base handling and interactive data query is continually increasing.

e) Data fact supplying systems of planning purpose have different degrees:

- The first one requiring the simplest and least preparatory work can be considered the variant in which the mere computing storage of data and their availability is ensured. The advantage of this variant is that data are always available for users and they can be processed by their own software means. Its disadvantage lies in the fact that the various technical and methodological preparatory tasks of processing should be individually organised in each case.

- Compared to the first, a more effective variant, particularly in the case of regular and wide-spread utilisation is when the development of data bases is envisaged. Data bases are computer data-supplying systems, which are well documented, available at any time and for a large circle of users, continually renewed, and prepared for multipurpose utilisation. The essential purpose of the development of this kind of system is to get rid of users from preparatory stages requiring special informatics knowledge.

In the majority of the cases, the practice has adopted methods connected to the first degree. This "historically" necessary way has been successful from two points of view:

- on the one hand, planners were able to obtain and make use of, through the computer park of the National Planning Office, the most important economic, social, statistical and financial data,

- on the other hand, the direct knowledge of the accumulating users' experience and of certain data stock has raised the claim for elaborating methods of information supply demanding much care and higher quality.

f) The internal and external conditions necessary to the development of the computer data-fact bases with planning purpose can be described by the following features:

- the internal conditions were essentially improved by methodological advance of the planning and by enlarging the capacity of hardware and software means. The National Planning Office, thanks to the Institute for Informatics and Methodology, is in possession of an organisation which makes coordinated development in the field of planned methodology and application of modern computer techniques possible.

- As regards the external conditions

- considerable advances have taken place in unifying notions of planning, statistical and financial information systems;

- possibilities of taking over data on computer data media have improved and significantly enlarged;

- in the Central Statistical Office and in some other institutions response for data collection, numerous well documented, regularly renewed and easily available data-bases are, nowadays, at our disposal.

g) types of data fact bases with planning purpose

- Data basis of the national economy balances plays a selected role in the accomplishment of planning tasks at macro-level: it constitutes a methodological framework and an essential data fact basis for pointing out and coordinating the main paths of economic growth and for determining their major meeting-points. The balances of the national economy, therefore, provide, even nowadays, a very important and widely used data basis of the planning. Since quite a harmony can be found between the methodology of the statistics and planning, the elaboration of these data bases does not need the solution of tasks which go beyond the usual computing technical preparatory works.

- Data bases of problem-oriented planning tasks

In the process of planning, from time to time, there is a group of tasks of a particular stress, which can be characterised by a special system of purposes and means. In order to solve them, there is a major need for special data and detailed analytical and planning methodology being more disaggregated as the usual planning aggregates. Problem-oriented planning tasks, which actually this time are, for example, the realisation of the government program for the economy in the use of materials and the modernisation of technology, or tasks of the planning of industrial structure. The common features of problem-oriented data bases can be summarised as follows:

- an information service suitable to a multifaced examination of the problem is provided in the framework of a system;
- data facts included in the data bases are stored in medium-long (3-5 years) homogenised time series,
- in order to facilitate the analytical work, they comprise - apart from the absolute data - a number of calculated indices, various types of indicators.
- they conform to the nature of the problem even on their aggregation level, and, if it is justified, they also make those data available which are broken down more deeply (e.g. enterprise- and product grouped or in certain cases individual enterprisal data) than in the usual planning aggregates;
- formation of enterprise-grouped data is carried out by mathematical-statistical method (on the basis of efficiency and profitability indices, the most characteristic ones have been chosen by factor analysis, then in the second step with the help of ELEKTRE multidimensional classing method, the order of enterprises has been determined. In the third step, the limits between individual groups have been established).
- Sectoral complex data-bases. They have actually been formed for both main branches of national economy, that is for industry and agriculture. The most important features of sectoral complex data bases are as follows:
- after their complete development all the important statistical indices of the sector are available within one system;
- indices of data-bases are stored in a hierarchic system;
- they comprise - when it is possible at all - long (15-20 years) time series as well;
- apart from the most important data in values, they also make some indicators available in physical terms;
- by means of a common nomenclature they make the different data of product groups comparable to each other and with the fundamental indicators in value as well;
- at last, the interim information constitutes a special sub-system, which serves to decrease disadvantages arising from the delay (due to preparatory harmonisation and collation tasks) of the annual data facts.

1.2. Systems of information formed in the process of planning work

Data facts are used by planners mainly for the analysis of past tendencies in a given field of economy in order to sum up the lessons and to estimate the determination for the years to come.

To reveal the complexity of the effects of decisions made earlier and to be made in the future, more knowledge is needed: e.g. to get acquainted with interest relations and behaviour or reactions expected of economic organisations, to take into consideration the possible cross effects of different measures etc. The latter are already the elements of planning work and belong to information created in the process of planning, as the data also do which relate to the supposed development in periods immediately preceding the plan-year. This information is not available within the framework of traditional supply of data-facts:

- either because the results of periods and events not yet happened should be taken into consideration,

- or because the verification and organisation of the data-basis of data-facts require quite a long period of time.

Therefore, data of the basis period immediately preceding the plan period should partly be provided by planners in the form of preliminary, expected or projected information. Consequently, these data formed in the process of planning are in (informatical, expected methodological or professional) relationship with planning data (with indicators calculated, decided, projected or estimated reffering to the future). All this allows handling preliminary, expected, projected and planning data jointly and organising them into common data-bases or data-bases joined to each other. Their handling of data-bases built on each other is partially essential if our aim is to intensify the variability of the planning work and to provide a computer-system ensuring appropriate decision-making possibilities for planners.

In order to meet the claims outlined above, experimental work to develop systems for producing and providing preliminary, expected and projected information have been started on the basis of computer data-fact bases. This endeavour will be achieved jointly with planners for some branches, and sub-branches of the industry.

The problems of data produced in the process of the planning work can be summarised as follows:

a) Calculation of preliminary data. A great deal of data-facts used widely in planning are provided by statistics only with a great delay, frequently with a delay of one or several years.

In many cases planners cannot accept such a great delay. They recur, in such cases, to the so-called "preliminary" data.

Actually two methods of producing preliminary data-facts can be taken into consideration. Information can be produced:

- on the basis of the interim (quarterly, monthly) data-facts with the same content,

- through applying representative methods (e.g. taking into account the product series data of production, realisation).

b) Estimation of expected data. In the practice of planning there is a regular claim to quantify data of a basic year, one part of which is not yet over and, therefore, it can be considered as a future period. Accordingly depending on the time ordered and concrete working phase of planning, the assessment of the future results of a period ranging from 3/4 year to 1-2 months and summing this up with data-facts arising from the mid-year observations of the past periods of the year have to be performed. Thus, from the point of view of organising information, forming expected data can be conceived as an interim task between the tasks of forming preliminary data referring to the past and forecast data calculated for the future.

c) Producing projected data. This group of tasks embraces forecasts for the plan period. In the first phase of the work forecasting individual indicators can be accomplished by simple means, which can be followed by econometrical modelling of the main processes. Apart from forecasting major macroeconomical data there is also a need for forecasting other primary (similar to statistical data used for planning) information which can greatly contribute to the computerisation of sectoral and functional plan calculations.

Through information services embracing all the phases of planning work we intend to realise some of the essential conditions and directions of the renewal of planning work. The development of information systems even by its partial results can contribute to improving planning and in the case of its final realisation, it will ensure the development of a new and effective planning methodology (technology).

A special field of applying data-facts and producing planning data is the development and running of models in the planning of the national economy. Since it is an important field of use in itself, the experiences gained will be summarised in the next part.

2. MAJOR ISSUES OF MODELLING IN PLANNING.

In 1979, parallel to the shift in economic policy, the attitude and approach of national economic planning to problems underwent considerable changes. The economic policy called urgently for the development of planning and the planning methods as economy entered the intensive phase of development. Planning models are natural elements in this development.

As the attitude of planning changed, requiring increasingly differentiated and multifaceted approaches, modelling followed suit.

Modelling used in economy-wide planning at present and in the near future should concentrate on the following major issues:

- Identifying and analysing the selective growth structure
- Detailed analysis of the economic equilibrium
- Coordination between the regulation system and planning
- Planning "blocks" of the economy.

We think that in the development of planning methodologies, the models should provide effective support to solving the above problems on the basis of versatile and problem-orientated information and methodology.

2.1. Consistency of Growth Trends

The current modelling practice considers the possibilities of annual and medium-term economic growth from several angles.

In the early stage of preparing the 7th Five Year Plan, we successfully adopted a simple, one-sector growth model which was used to produce several hundred macro scenarios. This was necessary because the forecasts available and the assumptions made in an early stage of planning may vary in a wide range. After selecting and appropriately classifying the quantified scenarios - which were systematically elaborated - a few typical scenarios were obtained. Different possible values of the following factors were taken into consideration for elaborating the scenarios: the change in the non-rouble export capacity, the required size of balance of trade (in line with the equilibrium requirements and the forecasts of the international money market), the change in import efficiency and the internal distribution of the GDP. The model solutions provided consistent scenarios for GDP, and domestic final demand, including consumption and accumulation.

In the subsequent stages of planning, we used models disaggregated according to the sectoral break-down of planning. Thus, the framework of the PROGNOSIS model system is taking shape on the basis of models developed earlier. The model system relies on three models which are different in their approach and the tasks they are oriented to.

The DINAMO model is intended to analyse the consistency of the volume trend of the real sphere planned in sectoral detail and their relation to desirable long-term development ideas. It is an organic continuation of the central volume model used in the 6th Five Year Plan, with its structure however being more appropriately adjusted to the planning categories and thus creating the possibility of "standby" modelling. This model compares the investment requirements estimated from the capital intensity of individual sectors with the investment possibilities which result from the projected changes in material consumption and import requirements at the planned level of exports and consumption. The model adopts the basic plan ideas for the items of final demand.

Major elements of the model are the sectoral input-output balances, lagged investment equations, import balances and the balance of the net amount of debts. It is a linear programming model in this mathematical form, using combined objective functions and maximising the value of the sum of the cumulative, discounted consumption and the sum of fixed assets at the end of the period. The tensions of the economic structure as mentioned formerly lend particular importance to the tasks of radical structural changes. Therefore we developed problem-oriented information bases in order to facilitate economic analyses at subsectoral and even enterprise level. In addition to traditional analyses, enterprises were classified on the basis of efficiency criteria with the help of factor analysis and a multi-dimensional ordering procedure. The first phase of the studies concentrated on three subsectors which are important for the Hungarian economy but are in an unfavourable economic position considering their relation to the central budget (these are coal-mining, ferrous metalurgy and meat industry). This was followed by selecting the opposite pole, i.e. subsectors which possess advantageous features for selective development.

It seemed justified to elaborate a prognostic model using a different approach to check the planned changes in volume trends. The econometric model known as FFD which is used for projecting the items of final demand describes the major decisive trends of the economy on the basis of the past year's statistics.The FFD is an econometric model which includes some input-output relations in addition to stochastic relations.

Besides traditional planning using constant terms and focusing on volume trends, price and income distributions have gained importance in recent years.The projection of price and income processes is supported by the price and income model (PRIN) which describes the domestic price and income trends under the planned system of economic regulations and at forecasted external prices, assuming given volume trends. The model can therefore be used to indicate the aggregate impacts of the changes in any one element of the regulation system and also facilitates considering and quantifying the various alternatives of the exchange rate policy and the tax system.

The combination of the above mentioned models gives a simultaneous forecast of the real tends, prices and incomes. International prices and export demand are often given as exogenous factors. Planning is to determine the projected producer and consumer prices as well as the real income which, if considered exogenous, can be used to calculate the path of real trends. Then with the help of the PRIN model, the prices and income can be determined on the basis of the real growth trend as forecasted by the FFD model and the expected changes in regulations during the period in question. The discrepancies between prices and income given exogenously and those calculated can supply useful information to create consistency in the plan.

The analysis of the macro effects of regulation changes is complemented by the models which describe at micro-economic level, i.e. for the enterprises operating under different conditions, the impacts of regulation changes on restructuring and the expected response of enterprises. Such model calculations have been made in the case of the wage regulations system, export promotion as well as to assess the expected impacts of the personal income tax and the value added tax currently under preparation and to coordinate them with the present system of accounting.

2.2 Study of Economic Equilibrium/Disequilibrium

The economic changes of recent years set the study of economic equilibrium as perhaps the most important task in planning work. The issue of equilibrium has evolved in planning in its full complexity. It was the issue of external equilibrium that was raised most sharply, however the tensions it implies are of course also felt in the internal balance situation and may exert their impact to the detriment of one another.

Model studies use a double approach: the objective we have set is to carry out a multi-faceted (static) study of economic equilibrium by setting up a general equilibrium-type model group and by making maximum use of the experience and information sources of formerly applied input/output models and models aimed at optimum allocation.

Issues related to equilibrium naturally imply the analysis of the disequilibrium in the economy. The multi-market disequilibrium model of the Hungarian economy was also prepared by using the disequilibrium theory. This model identifies the major tension points of the economy, based on the 1965-1985 time series.

2.3. Planning Intersectoral Complexes

Planning work has acquired a specific feature in recent years whereby in certain cases it discontinued the practice of sector-oriented planning and endeavoured to create a planning methodology for comprehensive complexes. This change is also reflected in the field of modern building. It resulted in models indicating the specificities of the individual blocks such as the agro-industries and the energy economy.

3. ON THE HARDWARE AND SOFTWARE BACKGROUND OF THE INFORMATION SYSTEM OF PLANNING

It is the Honeywell-Bull DPS 8 central system, installed in 1983 and its terminals that play a key role in implementing the information system of planning. Since 1986, the information-supplying activity is also supported by IBM compatible personal computers allocated at the major organisational units of the Planning Office.

Making use of personal computers has increased not only the quantity of performable tasks, but it has markedly improved both quality and efficiency of the automatic data processing applications. The previous conditions have been improved mainly by programme products which are relatively easy to handle, the direct interactive mode of the accessability of data and short response times.

The improvement of the quality of automatic data processing and the increasing possibilities incite, however, newer applications, raise newer and newer information claims and continue to advance demands, requirements towards their central system. Storage end processing of enlarged data collections means especially new problems because of the deficiencies of backing storage capacity and restrictions in performance of the central processing unit.

Among the software means applicable on the DPS 8 system, the basis of information work was ensured by systems ARGOS and LEDA completed by self developed products. However, new kinds of tasks require developments in this field as well.

Taking into account the bottle-necks of the system and the trends of improving the planning work, the tasks for development actually appear in several fields:

- The backing storage capacity of the system DPS 8 has to be enlarged: thus, while increasing performance and capacity, the reliability of services will also be intensified.
- It is necessary to enlarge the circle of software development tools and data handling systems.
- A system of local networks has to be developed for the sake of an efficient connection of personal computers to each other and to the central unit.
- A stock of updated personal computers has to be continually enlarged.
- When applying systems, it is necessary to ensure that planning experts can gradually acquire knowledge necessary to apply them and can get acquainted with possibilities provided by new software means.

A CANADIAN EXPERIENCE - GRASSROOTS

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1. GENERAL INTRODUCTION

Fuelled by a rapidly changing technological environment, Canada and other nations of the world are entering a new era. Everywhere existing linkages are being enhanced or replaced by new connections. The new era, variously labelled as "the third industrial revolution", "the post-industrial society", or the "information age", is a communications revolution, precipitated by the marriage of telecommunications, computers, and microelectronics. This marriage has fused the two technologies to create something "new under the sun".

In the past, computers produced a quantum change in our ability to create, process, store, manipulate, and manage information. But it was not until the computer was wedded to microelectronics and communications that the ability to transmit and control information was revolutionized. It is this happenstance, coupled to the symbiotic relationship between theory and production (as enriched by the constantly improving modes of communication) which is the transformative element for society, creating a series of challenges and opportunities of a scope and scale unimaginable since the heyday of the industrial revolution. The result is an economy based on information services and built on a new style of information management.

For the purpose of this discussion, one consequence is obvious: a new commercial information industry has emerged and the information technology which supports it (advances in computers, telecommunications, and microelectronics) promise to change the manner in which all nations make decisions, govern, work, play, study, and transact their business.

2. THE INFORMATION ECONOMY

An information economy is an economy in which the production, processing and distribution of information and information-based products and activities become the primary source of new economic growth. The notion of information-based or information-intensive services per se as a basis for a strong economy is not new. They have been important elements for the well being of society for thousands of years. What is new stems from three factors:

- For the first time in history, information-based industries have become the major source of economic growth;
- technology has altered fundamentally the amount, content, form and delivery of information services;
- the continuing rate of technological change surpasses any previous period in human history.

Stafford Beer encapsulated the essence of the change in 1970 when he noted:

"Society has become a complex organism, and it needs a nervous system. Managing the development of informational science and technology is all about this task. There is no other message than this."

At the same time, he advanced four fundamental propositions of information technology:

1. We can now automate whatever we can exactly specify.
2. Most (possibly all) ostensibly human prerogatives for inferential, judgemental, learned, and adaptive behavior can be exactly specified--at least with respect to finite contexts.
3. Within specified frameworks, much ostensibly institutional and creative behavior can be indistinguishably imitated by machine.
4. Distance is technically irrelevant.

Information exists only as an outcome of the interaction between the producer and user. It is transferable, transportable, sharable, consumable; and it lends itself to compression and codification for ease of handling.

Information is also both a resource and a commodity. As a resource, it is easy to produce, is infinitely renewable and expandable, accumulates like capital and is enhanced by use. As a commodity, it can be traded or bartered and gains added value through appropriate packaging and marketing.

One corollary to the definition and description of the information economy advanced earlier is that information must also become more commoditized, taking on more of the characteristics of a private economic good, like automobiles or steel. This commoditization of information is reflected in a number of ways in economies where the trend towards an information economy is most advanced. The debate in the United States over privatization of the publishing of government information or pressures in many countries to strengthen the laws for protection of intellectual property are but two obvious examples. It is also reflected in the emergence in the marketplace of a new and seemingly endless array of information services which are computer-communications based and electronically delivered.

One of the principal problems associated with commoditization is that a significant proportion of the change which has occurred to date has been technology-driven (in the sense that the technology provides new channels for product creation, packaging and distribution) with producers using these channels as alternative ways of bringing existing information to market. In the process, the quality of the information product is generally improved by being presented better or made more current and more easily accessible. It also introduces new costs which must be passed on to the consumer. But the technology which makes this possible does not in itself alter the essential quality of the information content, nor can it ensure the information will be used.

The use of information has many dimensions, but two are relevant for the purposes of the discussion relating to Grassroots:

1. whether the information, as presented, is used effectively, and
2. whether the information which is presented is the right information.

The first dimension of use has to do with the ability and willingness of the user to utilize the information system in question; and this use depends on the characteristics (training, attitude, etc.)

of the user as well as the characteristics of the system (presentation format, manipulation capability, etc.). The latter dimension is tied back to the question of the essential quality of the information. Information will not satisfy user needs if it is not timely, accurate or appropriate.

Overlaying both dimensions of use is a further consideration: is the system economic to use? Two aspects are important when evaluating the economics of use:

1. budget constraints - that is to say, is the information affordable in terms of the individuals or institutions budget? The answer to the question primarily involves the direct costs of use, including capital equipment requirements; but it should also take into account such indirect costs as personnel time. It is a concern which obviously applies to purchased information and will become increasingly important in view of the commoditization trend underway; but it is of equal concern for internally-generated and maintained information since the costs of collection, storage and retrieval are real costs even when the information itself is not purchased from outside.

2. cost-effectiveness - that is to say, is the cost of the system justified in terms of the benefits of the information and relative to the cost of obtaining the same information through some other means? For services based on the new technologies, these considerations are especially important because most of the new electronic database services offer information already available through some other means. The benefits of the electronic format lie in such channel characteristics as currency, speed, ease of storage, etc. But these are benefits which may or may not be valued highly by users and may or may not justify the higher cost associated with the electronic services at present.

A convenient way of summarizing the foregoing arguments is to be found in the standard economic paradigm of supply and demand. Technology has eliminated any supply constraint on the production and distribution of already existing information and the speed with which new information can be created. But, in general, the demand side of the market has not yet been forthcoming on the scale that was predicted and hoped for. The question to be answered is why? For example, is it because the information supplied on the new electronic information systems is not the right information or because users can't or won't use the new channels of information transfer or because the new channels are too expensive either in absolute terms or relative to other channels? One thing is certain: to date the market for information services in most countries has been largely supply driven, not demand driven. It has been shaped or determined more by technology than by user needs; and, contrary to what some modern marketing agencies seem to believe, supply will not ultimately create its own demand. Whether an information service or a new kind of bread, a product must meet some consumer need at an affordable price and better (per dollar of expenditure) than existing alternatives to survive and thrive.

This truism is reflected in the number of information services which have come and gone. User drop-out rates have been quite high for many services because, more often than not, users did not perceive the services as delivering the value that was promised. One concrete example of this latter argument involves the application of the technology to office automation. Here, there is a general recognition that the enormous capital investments to improve office productivity have not increased office effectiveness significantly, despite the promise of the technology. The major reason for this was that the machines and software initially offered to do the job were not well-suited to the needs of users. Libraries are another major institutional user which have suffered many similar setbacks. In short, when the product does not reflect real needs of users, the demand side of the market will have problems.

This conclusion is universally applicable. It applies to information systems as it does for all other products. For the case of information systems it applies not only to commercial services provided by third parties but also to internal, self-provided information systems. In this sense, the conclusions which can be drawn from examining a commercial service offering will also have relevance to the evaluation of internal information systems.

This paper is an examination of a commercial service offering in Canada--an agri-business service known as Grassroots. Although the service has some direct use in public administration, the use is marginal both to the primary information needs of government and the primary audience Grassroots is intended to serve. It does, however, have significant indirect implications for government. First, in terms of the governments traditional role as a supplier of farm information services and government regulation of agriculture and communications; second, as an illustration of certain generic properties of information systems which are important to the design and implementation of the governments own information systems; and third, as an example of how a third party can try to profit by packaging already available information, paid for by public monies, through distribution in different channels, with novel pricing policies.

3. THE CANADIAN CONTEXT

Canada boasts one of the most modern, advanced telecommunications networks in the world. The need to excel in the development of communications technologies and skills has been a constant of Canadian life, because the implementation, maintenance, and preservation of communications within the country has been the essential connection for the political, economic, and practical control which has enabled the nation to function and grow. This could not be otherwise for Canada when one considers its circumstances: one of the largest countries on earth, yet sparsely populated, with a harsh climate, a difficult geography, and a tradition of ethnic diversity. The additional factor of an extremely powerful neighbour to the south which has always been pre-eminent in communications and the rapidly changing global environment have provided further incentive.

Electronic information systems require at least three essential ingredients. One is a well-developed information technology infrastructure which Canada has. The other two are:

- adequate diffusion of computer technology, and

- a well-developed content base for use on the systems.

In these two latter areas, Canada lags behind many other developed nations.

A recent publication of the Canadian Department of Communications notes that there are more than 3,000 commercial databases currently available to Canadians. But this is a global figure, representing databases from all over the world to which Canadians have access by virtue of Canada's telecommunications network. They are not Canadian databases, they are not generally provided by Canadian vendors, and they are not produced by Canadian database producers. In fact, the number of commercial data based services which provide Canadian content is miniscule.

Telecommunications has created a global network which has made the world increasingly interdependent, with the ability to access information on a global basis (itself both cause and effect of this interdependence) of major significance. But the stimulation of a domestic database industry depends on developing an indigenous content base. In the case of Canada, this means produced and distributed by Canadians (though some would also insist on owned). The Grassroots Service grew out of a two-fold recognition:

1. since the information needs of Canadians, as for other countries, are not generic, Canadian users need information specific to Canada and/or adapted to Canadian needs;

2. an excessive reliance on foreign-produced database services cannot meet this requirement and will work against developing commercial information industries which are necessary for a healthy and vigorous economy.

4. THE GRASSROOTS SERVICE

Grassroots is a commercial farmer oriented database service operated by Infomart (a Toronto-based electronic information service provider), Cybershare (a Winnipeg computer time-sharing service), Comcheq (a Winnipeg payroll services company) and Manitoba Telephone (a provincially-owned telecommunications common carrier). In a number of ways, it represents a uniquely Canadian venture: a marriage of convenience between public and private enterprise. The service is available in Manitoba (where it originated), Alberta, Saskatchewan, and Ontario. It is linked and supplies content to Grassroots America, a service offered across Canada and the United States but used predominantly in Manitoba, Saskatchewan, Alberta and Ontario. It is run by Infomarts U.S. subsidiary and is available to users throughout the rest of Canada and other parts of the world through dial-up on Datapac (one of Canada's packet-switched data networks) and through Telecom Canadas Net or through Tymnet service.

Grassroots is a videotex service which uses NAPLPS, the AT&T-sponsored international-standard graphics protocol which is based on the Canadian-developed Telidon technology. As a Telidon/NAPLPS system, Grassroots incorporates a large amount of graphics and operates on a page format basis, i.e. content is constructed by pages which, in turn, are the basic unit of retrieval.

The basic Grassroots service uses an AT&T Sceptre terminal decoder attached to the users television set on one end and to the conventional phone line on the other. Transmission speed is 1200 baud but, because of the high proportion of graphics and the method of page reconstruction on the screen, the effective transmission speed is equivalent to about 300 baud. The basic service with the Sceptre terminal uses a numeric keypad for information retrieval. With appropriate hardware and software attachments, the service can also be run with a microcomputer which then permits the user to download files for later use and/or for manipulation and provides alphanumeric keyboard capability, an important feature for use of some of Grasroots farm management programs.

Costs (1) of using the system include:

- capital costs - the Sceptre terminal costs approximately $450. The microcomputer option, in addition to the cost of the micro itself, involves costs for a modem and decoder software averaging $1,800-$2,700 depending on the micro being used. If the user already has a micro with a communications package or would have bought one anyway for other purposes, the cost of the micro would not be assignable to the cost of Grassroots.
- subscription cost - there is a basic fixed subscription cost of $150/year.
- use costs - there is a connect time charge; users can also pay a monthly subscription fee with the usage cost placed at $19 an hour up to a monthly maximum of $300 per month for unlimited usage.
- communications cost - this is independent of the system charges and varies according to the method of access (conventional phone line, Datapac, iNet, etc.). In Manitoba, where the service

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(1) in Canadian funds

originated, there is a flat charge of $0.04-7/minute for communications from anywhere in the province when using conventional line service for access to the host computer or for access to the nearest Datapac node, if one is not located in the users local calling area. Others pay the cost of accessing the system through iNet ($.10/minute) or Datapac ($11.20/hr.).

In addition to these user charges, the service accepts advertisements on sponsorship for different database segments. This comes in the form of a company logo or name on the bottom of a page of information.

The system updates 25,000 pages per month, 1,000 pages per day. Through the telephone line, a user can access 15,000 pages. The database is divided into several categories, some of the main ones being: cash crop markets, futures markets, livestock, market analysis, farm management, weather, agency information, finance, news, and entertainment. The system is menu-driven, utilizing a tree-index format. A user thus proceeds through several levels to get where he/she wants to be. If one is already familiar with the system, it is possible to go directly to a desired file or page by inputting the appropriate code number.

Each of the main content categories contains a number of sub-categories or items, as follows:

- cash crop markets:	deferred delivery, prairie street prices, Ontario cash prices, and producer cars (selling directly to export rather than through grain company)
- futures markets:	Winnipeg Commodity Exchange, Chicago Mercantile Exchange, Kansas City Board of Trade, Chicago Board of Trade, Commodities Exchanges Centre, Mid-America Commodity Exchange, plus a primer to hedging and the use of the commodities futures market
- livestock:	Canfax West, Canfax East, Agriculture Canada Livestock Report, Chicago Mercantile Exchange, Deputter's Ag-Alert, and Bosquet's First Market News (daily); in-depth analysis from Broadwater Farm Services, Alberta and Manitoba Agriculture
- market analysis:	In addition to the newsletters mentioned above, CWB Summary, Western Wheat Grower's Association, Livestock Feed Board, Farmscene, OGCC, Cereal & Oilseed Situation Report
- farm management:	on-line programs to plan for herbicide use, producer car profitability, crop breakeven calculator, on-farm grain storage returns, sprayer, sprayer cost, machinery selection cost, land purchase vs. land rental, mortgage calculator, feedlot profitability analyzer, hog finishing profitability, harrowing returns
- weather:	market watch weather (reports nationally and globally), forecasts for your farm, agrometerology, Ontario and Prairies forecasts, North America short and long term forecasts, World Weather, and U.S. mid-west and western forecasts
- agency information:	Canadian Wheat Board, Canadian Grain Commission, Statistics Canada, Farm Credit Corporation, Prairie Agricultural Machinery Institute, Veterinary Infectious Disease Organization, Agriculture Canada
- finance:	Canadian dollar quotations, Toronto Stock Exchange, Interest Rates, commodity markets, business and financial news

- news: Newswave (videotex news), Canadian Press, Associated Press
- entertainment: Farm Living (shop at home, recipes, games, puzzles and quizzes, children's page, first age, home financing, travel, sports, classified ads, and lotteries

As of 1986, the number of subscribers to Grassroots was approximately 2,200, a figure far short of the anticipated subscriber base at the time the service was introduced. In turn, the small number of subscribers has dampened advertising/sponsorship revenues, an important source of revenue for the service needed to keep user costs relatively low. In particular, the service provided originally anticipated that a number of existing channels of agriculture information services would pay to put their material on Grassroots. Relative to expectations, little of this has happened to date.

5. LESSONS TO BE LEARNED

As noted earlier, Grassroots was created as a response to farmers need for a tool that would provide accurate and timely information at the farmers convenience and at affordable prices. It was, and remains, a service, aimed at farmers in general, but it is targetted more specifically at farmers earning $100,000 Cdn. or more per year, in the 25-45 age group, and raising cash crops or livestock sold in the open market. The income factor was considered important in terms of the information requirements of a large farm operation. The age factor was felt to indicate a greater willingness to use an innovative service and greater understanding and receptiveness to computer technology. The emphasis on cash crops and livestock sold in the open market was a reflection of the emphasis of Grassroots as a marketing tool. It was built around a system which could represent complex information categories through powerful graphic displays which condense a large volume of information into useful decision-making guides.

Yet, the Canadian subscriber base has failed to grow at expected rates. Low level penetration of the prime target market has been disappointing and the company has been experiencing financial difficulties. Grassroots America has already suffered major setbacks and has been reorganized. One of the results is a planned consolidation of the U.S. and Canadian services and a closing of offices throughout Canada and the U.S., with operations centralized in Winnipeg. This, in turn, may lead to some loss of local content.

Clearly, the target market for Grassroots was one that made sense. Farmers do have a need for information. Moreover, taken as a whole, the information on Grassroots would cost considerably more to acquire through other means, not to mention time delays and lack of currency in many other channels. Then why has the service not realized its potential?

One of the reasons for the poor record undoubtedly lies in the weak economic position of farmers in recent years, a circumstance external to the service itself and not to be blamed on the service provider. But several problems with the service and the behaviour of the service provider are also relevant:

- For many farmers, the capital cost of joining the system is a large outlay, especially when the benefits may not be readily apparent. The cheapest option (using a Sceptre terminal) leaves the user with a dedicated, non-programmable, limited function terminal, while the more expensive option (a micro) involves considerably higher costs and must compete with more sophisticated off-the-shelf software for management applications and other database services for information content.

- The use of Telidon/NAPLPS technology has resulted in an over-reliance on graphics, increased production costs, reduced response time (which can be psychologically irritating to users but also costly when there is a connect-time pricing system), and has required the somewhat cumbersome page file system. If the user is not overly familiar with the system, the tree-index can be frustrating as well as costly. More important, it inhibits "browsing," since there is no way to program a search.

- While it is true that the total information on the system would cost more to acquire by alternative means, few, if any, subscribers want all the information on the system (a fact which seems to be the case for most information services). Thus alternative channels selected individually and on the basis of real rather than perceived needs, may be cheaper.

- On the other hand, the present system does not contain some of the information farmers may want. The original concept for the service was predicated, to some extent, on the premise that all farm information services and organizations would join the system. They haven't. Moreover, in some cases, they have created competing services. Without the advantage of "one-stop shopping", the real cost of the system escalates. Although there is a lot of information in the system, much is of marginal interest to farmers on a daily, working basis. But the size of the file and technical aspects of the service often make it difficult for the individual to "manage" the information in the system in an effective way for their own purposes. This discourages overall use. Since the service operators allowed themselves to become preoccupied with extensive growth and did not pay sufficient attention to following up the problems and needs of existing users, viz-a-viz some of the problems noted, the system suffered a significant drop-off rate. (There are two corollaries here: 1) the market for electronically published information is smaller than one thinks and requires the building of greater national infrastructures than generally anticipated; 2) it takes more experience to run a successful electronic publishing enterprise than is normally envisaged.)

- The additional, separate cost for communications was an inhibiting factor for many potential subscribers. Moreover, for existing subscribers, it inhibits time spent on the system. Added to the cost of communications problem is the fact that many potential subscribers are from rural areas which do not have the level of network service (e.g. single party lines, appropriate switching equipment, etc.) to permit them to join.

- The system, despite its target market focus, has relied, to a large extent, on the "hype" of the technology to sell itself, rather than attempting to respond in the most appropriate and economical fashion to user needs. There is, however, one caveat which should be mentioned here. Where the applications of Grassroots worked for its users, it was a great system. A user survey of subscribers indicated the system added a mean $5,800 extra profit to those who could use the service effectively.

6. LESSONS FOR PUBLIC ADMINISTRATION

The Grassroots experience has a number of lessons for public administration, both in the direct sense of the impact of the service on government, and indirectly as an illustration of principles relevant to creating, implementing, and maintaining public information systems.

In the former case, the following considerations are relevant:

- Historically, governments have been primary providers of farm information needs. Private sector services, such as Grassroots, raise a major question of whether government should vacate the field to such private ventures. A basic conflict is created between governments desire to see commercial services prosper, thus adding to economic growth, and the social responsibility of government to provide its citizens with access to basic information. At the heart of this conflict is the tension between information as a resource and the trend towards the commoditization of information referred to earlier.

- Closely related to the problem of governments societal role is the fact that some of the information on Grassroots is, in fact, government supplied (e.g. weather). Grassroots repackages it and makes a profit from selling information generated by tax dollars and supplied free of direct user charges by the government. This is illustrative of a much more widespread issue for government in how to solve this problem for a whole range of so-called value-added services which involve the repackaging and resale of government-generated information.

- A number of regulatory issues emerge, such as whether the participation of Manitoba Telephone in the ownership of Grassroots violates the traditional content-carriage separation principle for common-carrier telephone companies or what the communications charges for accessing Grassroots should be, etc.

- The extent to which government should become a sponsor of Grassroots, using the system to distribute information to farmers which otherwise would have to be distributed in some other way must also be considered The dilemma is in drawing the line between the legitimate efficiency concerns of government and hidden subsidization of the service.

These are all important issues. But the indirect implications of lessons which should be learned from the Grassroots experience are, perhaps, more important.

- Any information system which government puts in place for the use of the public service and the general public good must, above all else, be appropriate to the needs of users at a price which is affordable, cost-effective and simple to use. Many of Grassroots problems emerged because, the planners did not heed this message. For example:

    - the technology employed is not necessarily the best for the job

    - the system is relatively costly

    - the content has not been seen by the market to be the most useful.

    These three concerns cannot be overlooked in any system designed for users, whether private sector or public sector, whether for external use or internal use.

In the Canadian case, there is good reason to believe that government information systems have, more often than not, been technology-driven rather than user-driven. Systems seem to have been installed because they were new, the most sophisticated or simply because they were what was available or because it was important to be seen to be utilizing the latest "elixir" for problem solving. There is little evidence to suggest that there has been a systematic determination of needs, followed by consideration of what kind of system and what kind of technology would best suit those needs. One obvious and upsetting example relates to equipment: there has been little attempt, despite the governments massive buying power, to get equipment manufacturers to produce or modify equipment to better fit the governments needs. (In this context, the similarity between many of the information systems introduced by government and the Grassroots system, despite its target-market emphasis, which has always been driven by the Telidon technology and the notion of developing a Telidon-based videotex service, without ensuring it was the best delivery system for users, is worth underscoring.)

- A second important lesson for government's own information systems lies in studying use characteristics of commercial services such as Grassroots. An internal information system, when it is a government system, has the problem that there may be no incentive to use the system efficiently or in a cost-effective manner. User costs for the individual user are often transparent in such a system. There may be a great deal to be learned from comparing usage levels and patterns in an internal system with those in a commercial system where the cost is not transparent, thus providing a strong incentive to use the system as efficiently as possible.

- Following from the preceding argument, a commercial service which is subject to a market test as to its acceptability and utility provides important lessons for government to study when developing its own systems which are not subject to such a test. It is all too easy to believe that a system is working well when there is no externally-imposed criterion for testing such a belief, or no complaints from users. This will be true for any internal system but is especially the case for government which lacks any external criterion of performance evaluation for most of what it does. Market tests should be arranged and evaluated.

Specific lessons of Grassroots relevant to developing and testing government information systems in these regards cannot be identified here because the basic investigative research has not been done. Further study is required. But it is important that governments recognize that such lessons may exist and try to undertake the studies necessary to identify them and analyze their meaning for government. Government is essentially an information industry--in most countries the major producer of information. Therefore, the sound and economical management of information by government is essential to the operation of government. There is much that government can learn from the study of other information industries, particularly in evaluating the success of information systems that are able to compete and thrive in an increasingly difficult and competitive environment.

Finally, the system and technology represented by Grassroots is not directly transferable between nations of great technological disparity. However many of the information elements involved (apart from those relating to capital-specific commodity markets) are of general value, and might be considered as design desiderata.

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STRENGTHS AND WEAKNESSES OF THE FRENCH SYSTEM OF SOCIAL AND ECONOMIC STATISTICAL INFORMATION

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INTRODUCTION

Since the end of the Second World War, nearly all nations have made an effort which is both exceptional and unique in the history of mankind for the development of statistical information. The statistical services of the most developed countries have been multiplied several times; in countries which have acceded to independence recently, the creation of statistical services has often been considered rightly as being one of the steps of national sovereignty.

In France, in spite of a fairly old statistical tradition - some consider it to originate from the days of Vauban, Minister of Louis XIV, or Necker, Minister of Louis XVI - the system of statistical information was fairly poor before 1939, being limited to some censuses or Civil Status statistics. It is only since 1946 with the creation of INSEE (Institut National de la Statistique et des Etudes Economiques) that an important effort has been made in France; even though this effort has been implemented in several stages which are too long to be enumerated here.

There is however an invariable element in this development: in nearly all countries, whatever the political and economic organisation which may have been adopted, the bulk of the the system of national statistical information is under the responsibility of public administration. This is not surprising given that:

- there are financial reasons: investment necessary in statistics is not only a lengthy process but also a costly one without any expectation of an immediate financial return; it is thus normal that this is taken care of by the state in the same way that the state takes responsibility for financing the education system;

- there are administrative and technical reasons: the collection and dissemination of statistical information presupposes the definition of conceptual and accounting frameworks as well as nomenclatures which are very similar in nature to the standardisation and regulatory activities of the state; these also presuppose the passing of certain laws and regulations not only to ensure that information can be effectively collected (laws on the obligation to provide information, for example) but also that the utilisation of the information follows certain rules (for example, respecting the confidentiality of information); finally, management files maintained by public administrations constitute an important source of statistical information;

- there are reasons linked to the utilisation of the information itself: public administration is still today one of the main users of statistical information.

The question of a better and wider utilisation of the enormous mass of information produced by statisticians has been raised for many years, on the one hand because the heavy cost of investment

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(*) Any opinion given in this presentation are the views of the author and not of the organisation which he represents.

justifies if not some direct financial return, an objective which is impossible and purely illusory, but at least the maximisation of what can be termed their "social utility", and on the other hand, because the conditions of operation of the contemporary economy requires more precise and better information.

It can be noted that French enterprises do not frequently and efficiently use economic information, either because they are not familiar with it or because they do not want to make the effort needed (in time and specialists) to gain access to the information, or even still because they believe rightly or wrongly that the information which is accessible is not the one which they need. Furthermore, when mentioning the needs of enterprises, it is often forgotten that these rarely constitute a homogeneous group. The needs of large enterprises, which often have a specialised unit responsible for economic research, are not the same as those of small and medium-size enterprises or industries. Nevertheless, whatever their size may be, all enterprises request a better knowledge of their markets, that is information on the development and structure of supply (production, imports, stock movements), of demand (exports, demand of the public sector, demand of households, intermediary demand, ...), the determinants of profitability (prices of inputs, salaries, rates of exchange, monetary and financial data, ...); the enterprises which are better equipped to process external economic information are interested in integrating these parameters together with internal information in some models; they also wish to possess information on the development of the social environment, on global economic forecasting, and even on the economic and social structure of different geographic areas in order to solve problems of choice of location. Of course, the information they wish to have access to do not relate only to France, but to the whole international economic environment and the main trading partners of France.

This large public has most often access to the information only through intermediaries: general or specialised press, professional press, consultancy reports, etc... This is not surprising. The nature of the information required by the different economic agents is as varied as the nature of their preoccupations, and objectives; it is thus very difficult to put at the disposal of all these agents information in the exact form which they require.

This is the main issue of the continuous effort of France to build its system of social and economic information. Certainly, social and economic information is not limited to statistical information. Even when it is used in an optimal way, statistical information is only one part of the information required by an economic agent, particularly an enterprise, which would use primarily information available internally (for example, management reports), and "commercial" information (reports of agents, economic press, marketing information, business opportunities, etc. ...) and financial information.

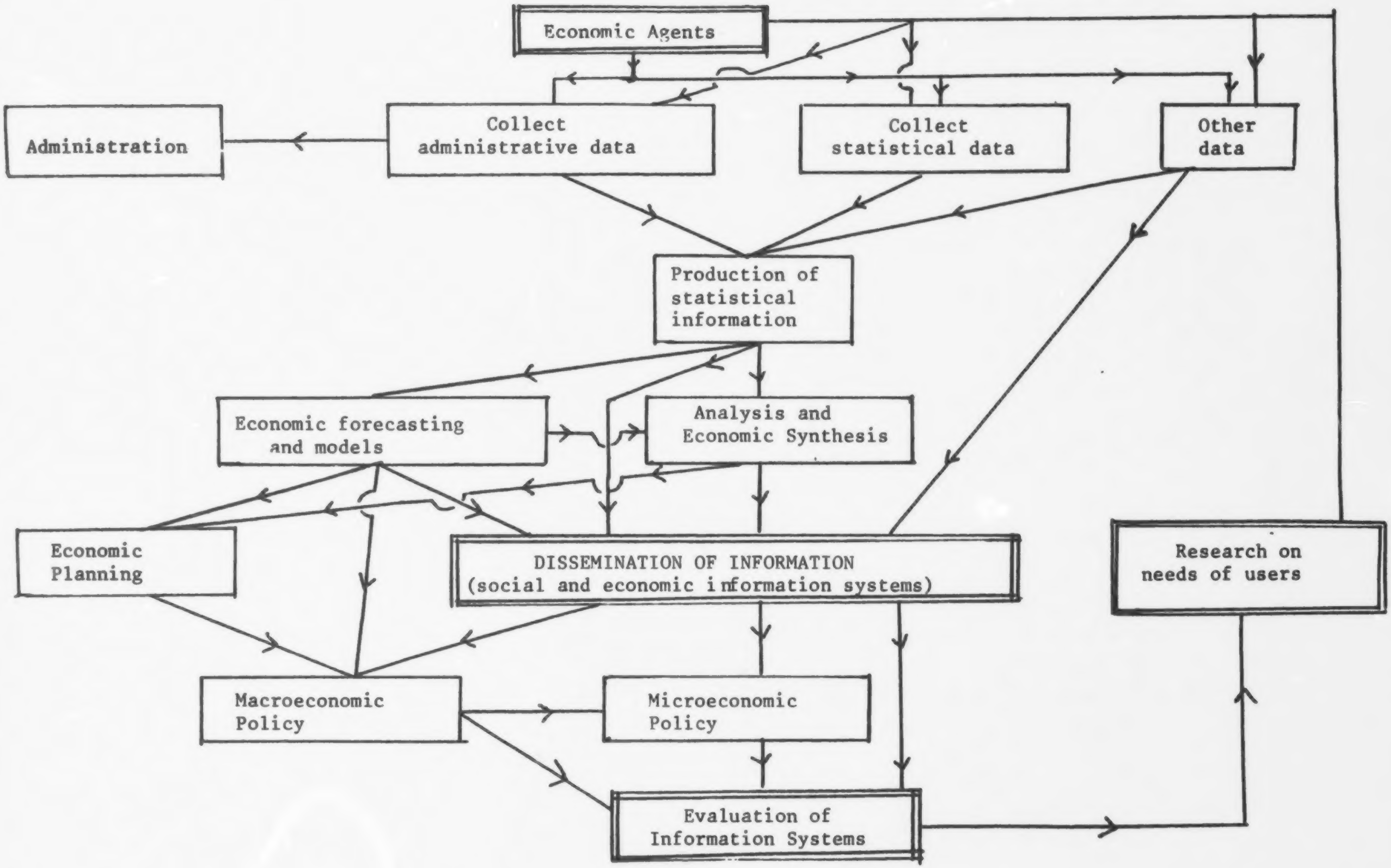
It is not possible to consider here all aspects of social and economic information, and this paper will be limited here to statistical information.

Outline of Presentation

In the first part, which will be the most important one, the French social and economic statistical information system will be described and analysed through its four essential components (see fig. 1):

- the subsystem for collecting and processing of data
- the subsystem for analysis and economic synthesis (including forecasting and macroeconomic modelling)
- the subsystem for dissemination of information
- the subsystem for the analysis of the needs of users (considered as a feedback to the three other subsystems).

Figure 1. Framework for analysing the social and economic information systems


Economic Agents
Administration
Collect administrative data
Collect statistical data
Other data
Production of statistical information
Economic forecasting and models
Analysis and Economic Synthesis
Economic Planning
DISSEMINATION OF INFORMATION (social and economic information systems)
Research on needs of users
Macroeconomic Policy
Microeconomic Policy
Evaluation of Information Systems

In the second part, there will be an attempt at analysing the strengths and weaknesses of this system.

The specificities of the French Statistical Information System

Before presenting each of the four subsystems consecutively, it is necessary to describe globally the whole system which contains some original characteristics.

The statistical system of a country can be organised in different ways; this is usually the result of either a conscious or a historically conditioned choice between centralisation and decentralisation. If statistical information is prepared by a unique central organisation, the system is centralised; if each organisation with specific portfolio responsibilities (agriculture, industry, ...) is responsible for producing statistics in its area, the system is decentralised.

More often, the system which is adopted is the result of a compromise between these two extreme options, with the predominance of one or the other. Thus, centralisation is predominant in Belgium or in the USSR, and decentralisation in the United States or Great Britain.

Decentralisation has certain advantages. When there is within a Ministry a unit specialised in statistics, this unit is more capable than an external organisation to exploit from a statistical point of view documents which have been designed and collected with primarily an administrative objective. Furthermore, it is easier for this unit to obtain responses to surveys from persons and enterprises who are in permanent relationship with the same administration. Finally, there is a better liaison between the unit which processes information and the decision centres in the administration.

On the other hand, there are certain risks with decentralisation: duplication, lacunae since the producer of information may opt to satisfy their own requirements only without deriving from the sources of information which they possess information useful to others, inconsistencies through the use of different methods, in particular different classifications.

The French system is rather decentralised: there are statistical units with specific responsibilities, on the one hand in various Ministries (Labour, Agriculture, Education, Industry, ...), and on the other hand, in a large number of public and parapublic organisations (Central Bank, Electricity Corporation, Railways, ...) or private organisations (Chamber of Commerce, professional organisations, ...). However, the role of the central organisation, INSEE (The National Institute for Statistics and Economic Research) both as producer of statistics and as a central co-ordinating organisation is much broader than that of other Central Statistical Offices in countries with a decentralised system.

In 1988, the total number of persons involved primarily in the collection and production of statistics in INSEE and the Ministries was over 10,000 with 7,000 at INSEE.

For a few years now, as a result of the development of statistical units in Ministries, the relative importance of INSEE in the global system is being reduced; this evolution is likely to continue. In addition, at the limit of the statistical system properly defined, other institutions whose primary objective is management (social security, banks, insurance, ...) possess a large amount of individual information which is still under-utilised.

Another characteristic of the French system is the role of INSEE in analysis and research.

In some countries, the output of statistical services are often limited to the publication of quantitative information, which is then utilised and studied by other organisations (public or private forecasting organisations, planning organisations, ...). In France, INSEE analyses the statistics which it produces, establishes national accounts with the collaboration of other organisations, analyses the conjunctural situation and prepares forecasts.

This role of INSEE is an essential characteristic of the French system, which is generally not found elsewhere; the organisations responsible for forecasting are in general always distinct from the official statistical organisations.

It is however necessary to note that INSEE does not have any exclusivity on any of the questions it deals with in its analysis and projections. Many other public or private organisations have competence on these questions. The current trend is a multiplication of these organisations.

The data collection and processing subsystem

The first important source of data is obviously statistical operations themselves, that is those operations designed only for statistical purposes. Among these are censuses, which are very large operations on the totality of the population studied (people, housing, industrial, agricultural, commercial enterprises, etc. ...), and surveys, which are carried out on a representative sample of the population; with the help of methods of mathematical statistics, it is possible to obtain from surveys results which are valid for the whole population. It is not the aim of this paper to compare the advantages and disadvantages of these two methods of statistical investigation; their respective cost is often the discriminating variable (the budget of population and housing census of 1990 is nearly 1,000 million francs, while that of a survey does not exceed a few million); it must be noted that INSEE allocates a lot of resources to the observation of prices, and particularly to the observation of retail prices (160,000 prices each month on more than 1,000 articles distributed among 295 classes of expenditure).

Another important source of statistical information is also information collected for purposes other than statistical ones. Thus, most data on income originate from returns submitted to social security or taxation organisations.

But it is possible to go further. Let us take the example of an enterprise. We may obtain various information which may be used for statistical purposes which are supplied by different sources: statistical survey, administrative documents (tax returns), register, ... If care has been taken to characterise the enterprise by a unique identification number, it is then possible to relate the information from the various sources.

An example is the SUSE system (Unified System of Enterprise Statistics) for which INSEE is responsible: computer processing makes it possible to merge data for each enterprise data from the tax return on industrial and commercial profit and from annual surveys of enterprises (statistical survey). The results obtained up to now have been used mainly for preparing the National Accounts, but a broader dissemination in the future will diversify their utilisation.

As for individuals, a method based on the same principles has made it possible to study, in conditions which are more or less unique in the world, the differences in mortality between different social categories. Many other examples could be given. We can imagine the immense progress which is made possible by such methods of merging data from different sources. These are used by INSEE only for general information in the context of the 6th January 1978 legislation on computers, files and individual rights and under the control of the National Commission on Computers and Liberty.

Finally, specific administrative sources are made up of the files or registers of individuals (subjected to Social Security, Tax, ...) of enterprises (industrial, commercial, ...) or of assets (cars,...) administered by specific organisations. Such files may also be used not only for the purposes for which they were created but also for statistical purposes.

Firstly, the analysis of the records of a file at a specific point in time provides a statistical inventory of the relevant population, and the analysis of the documents for the update of the file provides statistics on the movement of this population. A file may also provide a base for survey samples.

INSEE manages many files or registers; the following are exploited for statistical purposes:

- the register of enterprises and establishments (SIRENE);
- the register of large establishments;
- the computerised register of occupations.

INSEE also manages the register of identification of individuals and the electoral register which are not used for statistical purposes directly.

Compared to most other countries, the utilisation of administrative information appears to be more ancient and more intense in France. This is due partly to the fact that INSEE is part of the Ministry of Finance, which has facilitated the access to fiscal sources, and partly to the decentralised statistical system with specialised statistical services in other ministries.

This utilisation of statistical information of administrative origin has also expanded in other countries. It is, for example, well developed in the United States. However, access to individual nominal fiscal information on enterprises by INSEE (BIC) remains an exceptional case which makes interesting analysis possible. The periodical analysis of samples of the returns on Income Tax of individuals (called "survey of fiscal income"), coupled sometimes, in an anonymous way, with the responses to a specialised statistical survey, appears to be equally original. In a similar way for enterprises, the matching of data from BIC with data from the Annual Survey of enterprises appears also to be without equivalent elsewhere.

The law of 23rd December 1986, which gives statisticians access to classified administrative data, should lead to new improvements under the control of the National Commission for Informatics and Liberty.

The only case where the French practice seems significantly less positive than that of other countries, for example the Anglo-Saxon countries, is in the analysis of data from the returns for taxation on inheritance. This is normally carried out regularly elsewhere; in France, it is only carried out episodically, mainly because of lack of resources at the Taxation Administration.

The counterpart of this extensive use of administrative data is the limited use of exhaustive censuses, which have been limited for a quarter of a century to population and agriculture. In other areas, industry, trade, services, a less heavy and more up to date system has been set up; it is based on structural annual surveys usually of samples for the small units using extensively the register of enterprises and establishments.

A last original characteristic of the French system, on which it is not possible to elaborate here, is the conception of the investigations on economic agents based on the analysis of socioeconomic behaviour.

We can say, to conclude the description of this first subsystem, that the two modes of collection of statistical information present opposite advantages and disadvantages:

- statistical exercises, designed specifically by statisticians to study specific questions, provides more precise answers to the specific needs; but their costs may appear high given that their only purpose is to provide statistics;
- on the contrary, statistics obtained from administrative sources are less costly, since the collection of information is a by-product of administrative operations which would take place in any case, and does not require new investigations; but administrative regulations may be such that the statistics produced do not correspond exactly to the objects which have to be observed.

The Subsystem for Analysis and Economic Synthesis

The statistical data which have been produced and centralised become the object of further analysis by Statistical Services and INSEE using methods of statistical analysis (time-series econometric analysis, data analysis, etc...).

Furthermore, INSEE is responsible for synthesis, and, firstly to establish the National Accounts with the aim of providing a complete statistical representation, which is consistent with all the economic flows within the national economy and between the national economy and the rest of the world. This "model" of the economy takes the form of accounting tables which are more or less detailed.

INSEE is responsible for the global synthesis of the accounts and for their presentation to the Commission on the Accounts and Economic Budgets of the Nation; it establishes the accounts on households and enterprises as well as the table of industrial exchanges, or "input-output table"; the accounts for the administration, for financial institutions, and for the external accounts are prepared by other services of the Ministry of Economy, Finance, and Privatisation and by the Bank of France. From these separate accounts, INSEE establishes the overall economic table.

Detailed accounts are prepared for certain sectors - agriculture, trade, transport - and presented to the Commission on Sectoral Accounts.

In order to describe the short term economic development in a context which is consistent with the National Accounts, quarterly accounts are regularly produced. The first estimates for a quarter are disseminated during the second month after the end of the quarter. These accounts constitute a synthesis of the indicators on the short term evolution of the economy and play an important role in short term analysis and forecasting.

INSEE also produces regional accounts on enterprises, households, and local public administration.

Finally, within the framework of the expanded system of national accounts, "satellite accounts" are developed in order to describe specific areas of significant social importance: health, education, social protection, research, tourism, etc...

Many other synthetic reports are produced from time to time. These are produced to assist public authority in decision-making, for example, during the preparation of the Plans.

INSEE does not have the monopoly on studies, even within public administration. The Directorate of Forecasting (DP), The National Institute for Demographic Studies (INED), the Research Centre for the Study and Observation of Living Conditions (CREDOC), the Centre for the Study of Revenue and Costs (CERC), or the Centre for Studies and Research on Qualifications (CEREQ), to cite only a few, are important public research organisations.

Retrospective analysis which is possible using the studies described above improve the knowledge of the social and economic mechanisms. Projections are produced using the retrospective studies.

Projections are usually produced using an econometric "model". This is the case for the projection of the national accounts based on a "macroeconomic model". Using many equations and variables, these models represent the whole economy in a simplified manner and make it possible to take into account simultaneously a larger number of variables. It is then possible to study on a "model" the various outcome of different policies which can be imagined.

The main macroeconomic models established and used by INSEE are:

. DMS (dynamic multisectoral), model of annual paths comprising 1900 equations and describing the economy over the next 5 to 8 years. It is used particularly for the preparation of the Plans and for multi-annual sliding forecasts produced by the Bureau of Information and Economic Forecasts (BIPE), which is a private organisation.

. PROPAGE (sliding multi-annual projections). This model of 5000 equations has similar utilisation to the model DMS, but it is centred on a finer description of the productive sector (projection of the Input-Output Table).

. METRIC (quarterly economic model of the conjuncture). This model of 900 equations is produced from quarterly accounts. It is used particularly for the study of the conjuncture, and for the preparation of economic budgets. Its time frame is 3 years.

The responsibility for macroeconomic projections in the administration is shared between INSEE, the Plan Commission, and the Directorate of Forecasting. But the administration has no monopoly in this area. As is already the case in other countries, private initiative is becoming more and more active in France in the area of economic forecasting. We may quote for example, in addition to BIPE which cooperates with INSEE for the sliding forecasts quoted above, IPECODE, OFCE, IRES, certain banks, etc...

Finally, the requirements of general and urban planning as well as the changes in administrative and political structure in the regions have led INSEE to transform the "statistical services" of its Regional Directorates into real "research units" specialised in the regional aspect; this evolution which corresponds to the development of regional organisations in all sectors, is bound to develop further through the implementation of the policy on administrative decentralisation decided in 1982.

The work of the research units concern not only the region taken as a global entity, but also infra-regional zones: departments, new towns, rapid development zones, urban units, rural or semi-rural zones, employment zones, etc...

In addition to the imbrication within the central statistical organisation of the two subsystems which have just been described, an original characteristic of the French approach is that, even if since 1971, convergence with international National Accounts has been realised, more detailed and more integrated accounts are still proposed. Thus, a relatively detailed analysis of production and and the resources and utilisation of goods and services is still produced whereas in the United States and the United Kingdom, only global balances are currently calculated. This has made the existence of the Commission of Sectoral Accounts possible in France. The integration of the accounts of assets will be realised soon; very few countries are in a position to do this. The processing of accounting data of enterprises has made it possible to produce sectoral accounts and to articulate these with the microeconomic level.

In addition to what other countries generally call national accounts, other tools such as those just described have been designed: intermediary systems and satellite accounts which are inspired from the general accounting approach; other accounts, which are still partial, such as the accounts of natural assets, have been established and have required the development of original methods.

The subsystem for the dissemination of information

INSEE has made a special effort to develop its subsystem for the dissemination of information. Nearly 700 persons and !0% of its budget are allocated for this.

In 1967, INSEE created with the help of the Delegation to Regional Planning and Action (DATAR) the first two Regional Economic Observatories (OER). Today, each of the 22 French Regions has an OER, which constitute one of the services of the Regional Directorate or the Regional Service of INSEE. There is even an OER at La Reunion.

To respond to the demand of users, the OER stock themselves a large amount of information covering various areas: demography, health, education, employment, implementation and activities of enterprises, external trade, economic accounting, ... These information are presented in the form of:

- publications of INSEE at the national or regional level (the OER is responsible for the preparation of regional publications of INSEE) or by other services and organisations,
- unpublished statistical tables and results of studies; these tables are archived on paper or stocked on microforms (microfiches or microfilms) which make it possible to stock and distribute on a very small volume statistical tables and collections of studies.

These documents may be consulted at the Observatory, which also sells the publications of INSEE and photocopies of tables and unpublished results.

Through their close links with their regions, and their integration in the telecommunication system of INSEE, these 22 Observatories constitute a real network for the dissemination of economic and social information. Through their opening on the outside, and their integration in the regional economic and social environment, the OER acquire a concrete knowledge of the information needs.

The development of new techniques in informatics has produced new methods for dissemination of information. Computer files containing information collected during surveys and censuses and the statistical tables which are derived may now be exploited selectively on request. Particularly, from the SIRENE file of establishments, it is possible to obtain lists of establishments which meet certain criteria (nature of activity, location, ...) The direct utilisation of these files may be given under certain conditions. The possibility to disseminate information on diskettes for microcomputers in such a flexible manner never achieved before is being used now, while preliminary studies on the utilisation of CD-ROM have been carried out.

But, in spite of the systems which have been set up, a lot of effort is still required. It is clear that the implementation of a system of statistical data banks may improve the situation because by multiplying the possibilities of utilisation, they can adapt to the various needs of a diversified clientele, and they allow an increasing decentralisation of the utilisation of economic and social information.

However, although the implementation of such a policy started nearly five years ago, INSEE has still not overcome all the difficulties. One must not be unnecessarily surprised. The existence of a real data bank on a given theme does not require only the existence of data on this theme. It is also and specially important that:

- the data (generally produced by different agents with different tools and at different frequencies) is stored in an organised form so that they can be disseminated easily using information technology; they must therefore be well documented, classified, controlled and permanent;
- the data is conveyed to the user either through the use of cassettes, tapes, or diskettes, or using any of the telecommunication facilities available today;
- a complete set of services is made available to the end-users; this includes information system support (software for querying databases and for processing the data, space for the user to add local data, ...) and consultancy services (statistics, economic, management).

The storage of data in a bank is a most important operation: the fact that the user of the data bank communicates directly with the files in the data bank, and these are usually very large files, makes it important to ensure that the data is of the highest quality, well organised, up to date and consistent. All the advantages of the data bank disappears if for each consultation, the user had to phone the producer to find out what there is in the bank, how to find what is being looked for, and what the figures mean.

As for the services which have to be made available to the users, these are directly linked to the storage and communication functions; otherwise there is a risk of creating a big gap between the possibilities available through the data bank and the capacity of the users to utilise the system: If services for assistance and consultancy have not been sufficiently developed, whatever be the size of the data bank and its library of programmes, the risk of a failure of users - even experienced ones - is high whenever the requirement is slightly complex.

Furthermore, it will not be rare for users to wish that the assistance is extended to encompass other areas: economic, management, marketing, etc.

The development of information technology (communication networks, use of DBMS - database management systems, ...) make it possible today to set up statistical data banks.

A policy was proposed by the National Council of Statistics at its plenary meeting of the 6th January 1982. The important aspects of this policy are as follows:

- contribution of all statistical services to co-ordinated projects;
- implementation of several large projects and setting up the structure of co-ordination of these large projects;
- data banks for private users must be designed as commercial services whether they are set up on private or public servers; INSEE itself will provide such a service to a widely spread clientele through its regional offices and to a limited number (about forty) of administrations and public organisations with which it is in contact for exercising its mission;

- study appropriate measures to provide data bank services to social partners in the non-commercial environment;

- reinforce the administrative organisation responsible for the policy on data banks in France.

The large data banks of INSEE are based on these principles. There are at present two large data banks:

- the macroeconomic data bank (BDM)

- the local data bank (BDL)

to which it is necessary to add a documentation and bibliography data bank (SPHINX).

The macroeconomic data bank stores national and international series which describe the conjuncture in France and its commercial partners, macroeconomic indicators (annual and biannual national accounts, indexes, ...), statistics on structures such as employment, unemployment, external trade, etc... It contains at present 250,000 series and this is continuously increasing rapidly. It is distributed by the GSI-ECO server. The main international servers of macroeconomic data banks, DRI and WEFA also contain information on France.

The local data bank contains all the statistical information available at the municipal level, and soon at the level of districts in the urban municipalities. Nearly 5,000 indicators, mostly from the census of population or agriculture, the analysis of the register of enterprises and establishments (SIRENE) or fiscal files, are contained in the local data bank. It is distributed by COREF, a private company specialised in local market studies, surveys, specialised mailing, etc.

The subsystem for the analysis of the needs of users

The important effort of INSEE for setting up its dissemination subsystem has made it easier to listen to the needs of users. The quality and frequency of the contacts between "disseminators" and "producers" of information in the same organisation guarantee that these needs are taken into account. The setting up of relaying contacts and intermediaries which use statistical information obtained from INSEE which are then redistributed with more or less value added (for example, the data bank servers) has contributed to improve the relation between users and producers whenever it has been possible to establish a dialogue between INSEE and these related contacts and intermediaries.

Other more institutional organisations have been set up to improve this "feedback"; the most important being the National Council for Statistical Information (CNIS).

The Statistics Act of the 7th June 1951 which covered the obligation, co-ordination and confidentiality of statistics, had set up a Committee of Co-ordination of Statistical Surveys; this was transformed into a National Council for Statistics by a decree of 8 December 1972, which itself was transformed into a National Council for Statistical Information by a decree of the 17th July 1984.

The council is chaired by the Minister of Economy, Finance and Privatisation; the Director-General of INSEE is the Vice-Chairman. It is comprised of representatives of Parliament, and of the Economic and Social Council, of each ministry and some administrations which have a global view of the problems of statistical information, of professional organisations and trade unions, as well as some individuals chosen because of their expertise in statistics or as users of statistical information. INSEE provides the secretariat.

The Council is to ensure, as far as the statistical work of the public service is concerned, that there is consultation between the services responsible for these work and the users. For this purpose, it examines and gives its opinion on:

- the general development and the annual scheduling of the statistical production of the public service;
- the programme of censuses and surveys, of statistical analysis of data from administrative systems, on the nature of the information which should be obtained from the implementation of these programmes, and on the method of dissemination;
- potential improvements on the method of preparation of statistics and their dissemination by the public service;
- the design, revision and updating of the main economic and social nomenclatures.

Every year, the Council establishes the programme of official statistical surveys. The visa allocated to a survey by the Council makes it compulsory for all physical and legal bodies to provide answers to the questionnaires; as a counterpart, they are given the guarantee of the confidentiality of the information. In addition, in the context of the Plan preparation process, the Council establishes a programme of activities over five years.

Although the Council is the most important institution in which issues related to the production and utilisation of statistical information is debated, there are also other institutions involved with the same issues.

In 1952, a Commission on the Accounts and the Economic Budget of the Nation was created. Although this Commission is first and foremost an instrument of economic policy, the preparation of the National Accounts contributes to statistical co-ordination, by unifying the methods of observation (concepts and definitions) and of accounting and by making it possible to discover areas which are insufficiently known. Subsequently, Commissions have been created for specific sectors: transport (1957); trade (1963); agriculture (1964); health (1970); social security (1979).

More recently, a Research Council has been set up under the responsibility of the Director-General of INSEE with the responsibility of guiding and defining the needs in this specific aspect of the work of the Institute.

Finally, we can mention the National Commission on Activity and Product Nomenclatures created in 1970 with the responsibility for implementing and updating the nomenclatures of activities and of products used in the whole administration for both administrative and statistical uses. It is chaired by the Director-General of INSEE; its secretariat is provided by INSEE with the assistance of the Directorate-General of Customs and Indirect Taxation.

Strengths and weaknesses of the French system of statistical information

The strongest aspect of the French system is undoubtedly its higher degree of integration than in other developed countries.

The co-ordination of statistical activities and the coherence of data produced are objectives which are common in all countries. However, these seem to be better achieved in France albeit imperfectly yet. This is due primarily to the existence of general instruments of co-ordination which are used not only for statistical activities, but more generally for the management of public administration.

Through the register of enterprises and establishments, it is possible to obtain the identification and coding of the fundamental units which are common to the whole administration; this facilitates the utilisation of administrative information and its articulation with data from statistical surveys. France is one of the few countries where statisticians are so closely involved with the design and management of such a general instrument.

In all countries, there are nomenclatures for basic activities; the French methods differ on at least three counts: a more coherent application of the nomenclatures based on the code of the main activity, better integration of the nomenclatures of activities and products, an extended administrative role for these nomenclatures as a common language for the administration even for its regulatory activities.

The development in France of standardisation of the general accounting of enterprises around the General Accounting Plan (Plan Comptable General - P.C.G.) has equally facilitated the integration of statistical information systems and the utilisation of accounting information. The categories of the P.C.G. serve as reference to the fiscal administration as well as to statisticians.

The decentralisation of the French data collection system is also one of its strength insofar as it is more efficien in taking into account the needs of users who are in direct relation with the producers, particularly those users in the different Ministries who have the responsibility to establish the economic policy of the country. This characteristic also applies to other actors in the economy: for example, the construction enterprises go more readily to the statistical services of the Ministry in charge of this sector since they are permanently in contact with other services of the same Ministry in charge of social policies, regulations, public orders, etc...; they would be more reluctant to call for information from a central statistical service.

Other countries, such as the United States or the United Kingdom, also have a decentralised statistical system. But in France, it has been possible to maintain in spite of this decentralisation a strong consistency of the whole, not only because of the high integration of the statistical information system, but also because of a certain number of concrete measures, both legislative (INSEE is officially by law responsible for the co-ordination of the whole system) and practical (it is INSEE which is the "source" of employees for all statistical services, and which is responsible for their management; furthermore, they are all trained in the same institution, l'Ecole Nationale de la Statistique et de l'Administration Economique - ENSAE).

The importance of the efforts made for dissemination and for receiving feedback from users is also, as was pointed out earlier, one of the strengths of the French system.

Finally, the fact that INSEE is present at both national and regional levels guarantees that needs at all levels are taken into account.

On the other hand, it is necessary to point out that France is backward in using modern methods of data collection and in implementing sampling methods. Data collection operations for surveys and censuses are currently characterised - depending on countries - by different mixes of methods: use of enumerators, of postal methods, of telephones, etc. The French methods seem less modern than those of other countries such as the United States or Canada. The differences in the practices are explained mainly by socioeconomic differences between the countries in relation to factors which are as elementary as the extent of the territory concerned: earlier generalisation of the telephone network in the two countries mentioned above, earlier modernisation of American agriculture. The French system is evolving cautiously in the same direction: increasing use of postal methods in agriculture (they are commonly used in other sectors), experimentation with the use of telephone enquiries for households. Progress in communication technology is likely to transform significantly methods of data collection, particularly for enterprises. Experiments using the Minitel have already taken place in France, but the use of portable microcomputers for data collection is still not developed. It is also necessary to mention the use of teledetection for establishing statistics on agriculture, the environment, and land utilisation. The advance in these areas of the United States and Canada is not only due to their size. France is also developing in this direction.

The weakness of the French system is probably more important in the area of utilisation of sampling methods. These methods are used in order to reduce the cost of statistical data collection for surveys and for the administration. But there are in France too few experts in this area. This may have as consequence a mediocre optimisation of sampling plans, an inaccurate estimate of the accuracy of the results, insufficient control on the quality of the data.

In the field of dissemination, France is also less advanced than the countries of North America where the role of the private sector is more developed, particularly in the area of dissemination of macroeconomic information. To be exact, this problem is not specifically French, but rather European: in Europe there are many obstacles which have not made the emergence of a large server possible :

- fragmentation of the market in so many national markets, none of which is sufficiently large to make a national server profitable quickly;
- important cultural differences between Europe and the United-States concerning the value attributed to economic information, which European enterprises are not prepared to acquire expensively or even at its right price;
- existence of a large number of public and para-public institutes who accept to sell information with a high value-added and forecasts at the marginal cost of providing the information to the user; this makes it difficult for a profitable private server to emerge.

May I be allowed as a conclusion to go somewhat beyond the topic of this presentation to reflect on the respective roles of the public service and of commercial servers in the dissemination of statistical information; this is a problem which will play a central role in the next ten years for the improvement of the dissemination of statistical information.

Only forty years ago, public authorities were practically the sole users of the statistical information produced by their own services. Today, the number and variety of users have considerably increased. Data from censuses have become an essential element in regional and urban planning. Enterprises in the United States, and to a lesser degree in Europe, consider nowadays statistical information as an important component of the external information which is necessary for the development of their development strategy and of their commercial activity. Above all, statistical information has also become an essential component of the political and social debate, and for this reason, has become indispensable to politicians, leaders of trade unions and other types of associations, in short to the citizen.

Given this evolution, the production of statistics in the public sector has reacted by increasing the number and variety of publications, by creating new media for dissemination such as microfilms, magnetic tapes, diskettes, data banks which complement the paper media and make it possible to personalise the product which is supplied.

The cumulative effect now results in a very important volume of information which has to be disseminated to a clientele which is also increasing rapidly and highly diversified. There is thus a threshold effect on the public system of statistical information which forces it to reassess firstly the nature of the information which it produces; is it a consumption good like any other, or on the contrary, is it a public good or even a cultural object ? As a corollary, should we invoice for making information available and if so in which way: payment for the information itself or only for the services which are included.

On these contradictory issues, it has up to now been difficult to obtain a common approach. The information used by an enterprise can be considered as one input among others, which contributes to the calculation of the price of the product it manufactures or the services it distributes: it should thus normally be billed like the supply of electricity or the transport of personnel which may or may not be provided by public enterprises. Another approach: the information used by the citizen to allow him to participate in political, economic, and social debates is public information, already paid for through income tax, which he can request for no additional cost other than the marginal cost. And how to analyse the case of a trade union or other association which will use the information in the interest of its members, but because it is a non-profit organisation cannot pass on the cost of the information in the price of its services. What is the situation of the student who expects rightly from his university the documentation which is necessary for his studies or research but has to have recourse too often to statistical services. Four examples which call for a remark: is it the same information in the same form which is used for operational needs by a professional user or for enriching the economic culture of the user-citizen ?

We should add that the dissemination of information has for a long time no longer been the monopoly of the statistical services which produce them. In addition to the media (general or specialised press, radios, televisions) and the institutional relays such as the Chamber of Commerce, professional organisations or trade unions ..., there are now commercial organisations providing services or research which redistribute statistical information with more or less value added. The variety of services expected by various categories of users and their adaptation to the needs of each one require a personalisation of the service which often includes an important part value added in the form of consultancy services. Public statistical services a priori do not have the flexibility and means necessary to respond to this multifaceted demand for various types of information (statistical, but also legal, commercial, bibliographic, ...) which are combined into a synthetic information adapted to the problems under study. They cannot however be totally disinterested in with this type of dissemination since the basic information which is thus circulated is nevertheless produced by them: although they cannot be held responsible for the utilisation of the information produced by them, public statistical services still feel concerned for deontological reasons by the quality of the information circulated.

This is one of the challenges for those who are responsible for statistical information systems.

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METHODOLOGIES FOR PLANNING, DESIGN AND IMPLEMENTATION OF INFORMATION SYSTEMS IN GOVERNMENT

THE MERISE METHOD

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1. THE GENERAL CONCEPT OF THE MERISE METHOD

1.1 Systemic Approaches

Occidental means of reasoning are greatly made up of a string of thoughts, rationalism, which dates back to the ancient Greek era, and more specifically to the time of Aristotle. In France, Descartes contributed to the development of this type of thought, by considerable means dealt with in the Discourse on the Method.

It has taken years to see so-called globalist thoughts reappear in the West proposing a more complicated approach rather than a simplified one.

This new approach which is rather distant from the cartesian logic is closer to the simplified views of other more ancient civilisations than ours.

It takes into consideration the fact that a whole is more than the total of the parts: a complex system such as an information system, is made up of a coherent set which has greater density than all of the elements put together. One of the major reasons for this state is that these elements interact and can not be detected if studied on an individual basis.

The French systemics theorist, J.L. Le Moigne, gave his views on what he thought were the four precepts of the new discourse on the method. These are highly different from the rationalist precepts of Descartes:

. They no longer need to be obvious, they try to be more pertinent for the observer.
. Considers the object not as a set of parts but as a whole which is part of the environment.
. Does not limit the study of behaviour to the study of its causes.
. Does not aim at being exhaustive but at being representative.

To outline the properties of a real system, it is sometimes necessary to use modelling; a techniwue for analogical representation. The form of this representation can be varied: graphic, textual, mathematical, ...

Several objectives can be reached with the use of modelling:

- simplification : in providing what is esential, which is a pertinent summary of the goal to be reached, it becomes comprehensible.

- communications : the model is a standard for dialogue.

- demonstration : the use of an isomorphism between the model and the artificial goal whose properties have been idenfified allowing the identificaiton of the behaviour of the real object.

Simulation is the operation which consists in testing the model to evaluate the pertinence and the scope of validity. For the more complex systems, introducing a great number of variables simultaneously, the operation can have a need for greater means.

1.2 Merise and Systemics

Merise, a method for design and specificaiton of an information system, has integrated several elements derived from "systemic thought operations".

. In its concept, Merise follows the global approach by level of abstraction.
. In its procedures, the method provides the designer a systemic form of shorthand:
goals, unalterable items, cycles of abstraction, modelling and decision.

Lastly, the tools Merise can adopt are adapted to the representation of the complex systems : individual formalism of data, Pétri networks.

2. THE PROCEDURE

2.1 The levels of description

The levels of description each correspond to :

. a level of different needs which defines a type of choice of design
. a level of abstraction being different in terms of perception of the system, each level being a detail of the preceeding level.

If three levels are selected, the type of choice of design is then the following:

- the choice of management, for example
. doing pre-invoicing or post-invoicing
. establishing systematic controls of files before dealing with them or dealing with them without controlling them and then doing test controls.
. allocating certain goods to a specific stockroom
. taking into consideration the fact that a custoper's order can be delivered several times each delivery leading to invoicing

- the choice of organisation, for example :
. reviewing the task-sharing between the editor and the secretary in an Administration
. deciding, when performing a banking operation, if the operation is to be allocated to one or two posts for a given customer.
. using for a given post a given type of material.

- technical choices, for example:

. installing at a given location a terminal of a given make
. executing a given operation in a given programme
. inserting a given piece of data on a given disk with a given indicator.

The tools which can represent the levels of description are the models; each level of description corresponding to a level of the model.

We have adopted the most frequently used terms to name these three levels, that is:

1. the design level
2. the logical level (or organisational)
3. the physical level (or operational).

It is appropriate to note that these three levels of description are not of the same nature as the two well-known levels in management informatics, ie functional and organic which correspond to a classical design process : idenfying the needs during the functional analysis, dividing into programmes and files during the organic analysis.

These three levels of description are not the three stages in the MERISE procedure.

2.2. The Major Stages of a Project

The dividing of a project into homogeneous states is what we have termed the methodology of the procedure.

The decisions to be made involving the actual length of the project are in fact justifications of the divisions.

Furthermore, as soon as th project gets to a rapidly obtained determined size, that is in a few dozen man-months, it quickly becomes clear that it is not possible to wait until the entire field of the project is analysed in order to finally begin the design and implementation.

These two points are linked, but first we will sudy the nature of the decision to be made.

Amongst these decisions, the first and not the least, involves of course the setting up of all or part of the project.

Should it be based on Strategic Planning for Information Systems or alternatively based on a diagnostic? Not at all, because the impact of the implementation of a project on the functioning of the organisation or of the firm implies that it will be taking additional risks, which should have been thoroughlly examined beforehand. Furthermore, the design and implementation of the project are long and costly procedures and it is out of the question to wait until the end to evaluate the risks and to then realise that another solution would have been more appropriate.

If strategic planning does exist in a given organisation, it will have determined then updated the role which will be played by informatics within the organisation in the architecture of its orientations with regards to its long-term developments, taking into consideration the appraisal of its fundamental risks and expected benefits.

However, at the development stage of a project involving a given field of the organisation, it would be the best time to have a close look at the risks and expected benefits involved, that is to develop a preliminary study of the project which could globally determine the functional and technical solutions, taking into consideration on the one hand the state of the existing situation and on the other hand the requested orientations, which allows for the evaluation of the costs of the new system as well as the impact on the organisation even on the content of the strategic planning itself.

The decision to be made at the end of the preliminary stuy leads to a choice between several possibilities :

. withdrawal or postponement of the project

. modification of the field of study and return to the preliminary study
. pursuit of the project in deciding on a functional and technical solution and deciding on the means of accomplishment (methods, planning, etc).
Such a decision is to be made by a high-ranking official or a body or high ranking officials (Informatics Committee, General <management).

If the project were to proceed, should the development be implemented immediately?

No, because the premliminary study, owing to its global characteristics due to the need to rapidly and cost-effectively lead to adopting a solution, has led to the agreement of the users on the major points of the project only, and not on the detailed ones, which therefore prevents the launching. A decision made by each of the users is then required on the detailed specificaitons of the part of the project which is visible to them and which they are involved in.

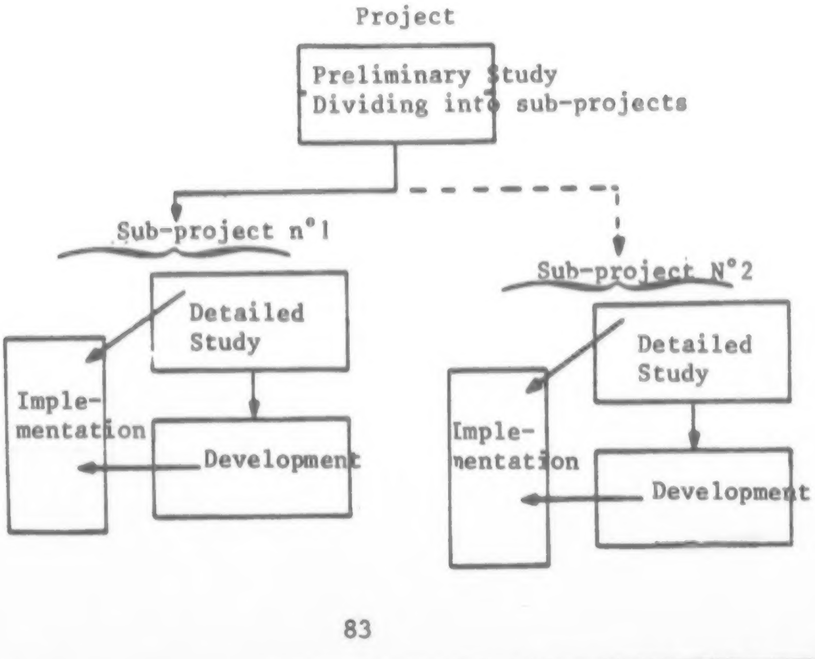
That is the main purpose of the detailed study.

Aside from these specific decisiosn, the detailed study can lead to the evaluation of the costs of operating and manufacturing and to confirm the decisions concerning the operation?
The choice of the material.
The following decisions are made for each sub-project. They involve, at the end of the stage of development , the decision to implement the project and the methods at the end of the implementation and the tests in real life situations. All of these decisions must be made taking into consideration the fact that a change in leadership is possible, that is that the results obtained from a given stage can be put into operation by a different leader thatn the one who ran the preceeding stage.

That is why MERISE has opted for the following major steps, which are most likely to abide by the conditions formerly mentioned and stated below:

. *Preliminary study*
. *Detailed study*
. *Development*
. *Implementation*

An illutration in time of the sequencing of the steps in the case of an important project could be the following:



In such a sequencing, it can be noted that the preliminary study involves the entire project and for the detailed studies of the sub-projects which it has defined.

Detailed study,Implementation, and Development are done by sub-projects following the coherent guidelines established in the preliminary study.
The Implementation (training of the users, creation of files, installation of material, changes) can actually begin without waiting for the results of the detailed study, but the same does not hold for the Development.

Lastly, the sub-projects can be carried out simultaneously or one ofter the other or with partial overlappng.

The final decision made with regards to the sub-project is then a definite acceptance.

SUMMARY

. The preliminary study defines the global and general structure of the system. It leads to the selection of a general architecture of the soluton and defines the interfaces between sub-projects.

. The detailed study refines the architecture by integrating all of the functional elements related to a sub-project following the general architecture.

. The Development finalizes the description of the sub-project in machine-readable terms.

. Aside from the physical locations of the work stations, peripherals, etc. , the implemntation leads to publishing of literature adapted to each user and which is the version of the part he is involved in with regards to the preceeding descriptions but which he can interpret himself

3. MODELLING

The concepts dealt with by MERISE are, for the most part, the elements which allow a system to be described from the level at which we are located.

These concepts are of course not entirely innovative. They have sometimes been used in certain methods and research projects. Even in those cases, it was necesary to select the ones which provided a homogeneous entity which was in respect with a given philocophy and a coherent strategy and to have defined a compulsory form of semantics.

At each level of description, the concepts are grouped into two distinct scopes of interest:
.the data
.the processing.

It is indeed useful to keep the two fields distinct in order to avoid having the operation become monolithic and difficult to handle in standard contexts.

Above all, if the activity of the organisation is generally the result partially owing to the systematic repetition of identical or similar tasks: the billing, the pay, it also involves the performing of specific tasks with inforseeable nature and whose purpose is generally to produce elements which allow to adjust depending on the conjuncture to better guidance.

Therefore, in certain cases, it is possible to be based on well-established processing, whereas in other cases, an "information base" is to be used but in this case all uses to be made can not necessarily be foreseen.

Depending on the contexts, the procedure will determine if the 'data' or 'processing' or in the more complex cases a simultaneous and complementary approach is to be adopted.

3.1. Description of the Data

This level is used to provide the data which can determine the semantics of the Information System, that is , it is to give each word of the vocabulary which is used to illustrate a firm's activity a precise meaning, and most particularly in ilustrating the relations between the meaning of the different words.

The concepts to be used for the DATA Design Model are the following:

3.1.1. Conceptual level

PROPERTY
This is the smallest bit of logical information handled by the firm and which has meaning in itself. the property can be simple: supplier name, month, unit price, or compound, date, (day, month, year) address (name, street, number, postal code, district), if the corresponding set makes up a semantically new information from its components.

OBJECT (or individual)
It is the illustration of an entity manipulated by the organisation whereby it agrees upon being distinguished by having its own existence outside of any given context.

Each object is described by a list of properties which are specific to it, and to a given set of values taken on by these properties corresponds to an occurence of the object.

IDENTIFIER
It is a special property of an object such as there are no two occurences for this object for which this property could take on an identical value. It can be noted that the definition of an identifier is often the result of a choice of management.

RELATION
It does not in fact really exist, that is, it is inferior to the former existence of the objects which it groups.

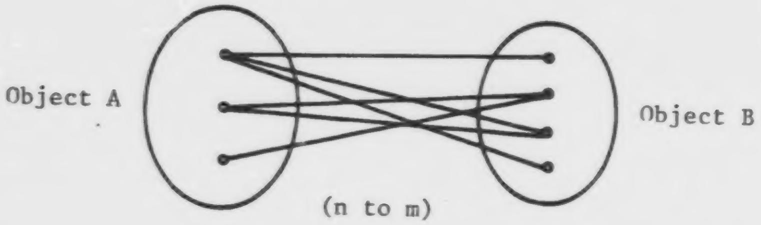
CARDINALITY
(The minimum and maximum number of occurences of an entity that can be involved in one relationship).
It illutrates, for each object-couple relationship, the minimum and maximum number of occurences of the relation that could exist for an occurence of an object; it is represented by 0,1 or 1,1 or 0,n or 1,n.

This representation is highly semantic and the image it gives of the organisation provides information which is highly stable, that is information which has a high degree of stability in time. In no way does it propose a hypothesis on the use which will be made oof this data (access, organisation, etc.) it is the illustration of some fundamental alternatives for management illustrated by the identifiers and cardinalities and has no reason for being modified in the architecture unless the organisation radically modifies its social reason.

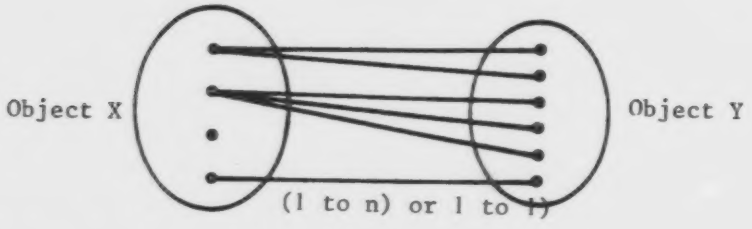
3.1.2 Logical Level

It involves as regards the data, a transposal of the representation of design level which is capable of providing a definition of the logical structures for establishing data needed in the automated part of the Information System.

Indeed, in order to completely represent the semantics of the Information System, the concept of a relation is to put n occurences in correspondance with m occurences of one or several other objects.



Whereas the management systems of existing data - SGBD or of traditional files - can only establish relations of the following type:



The transposal then weakens the semantics of the representation, but owing to the formalism which has been adopted to illustrate the hierarchies of the logical access; it would then be possible to optimize implementation of the Information System and to guide the designer in the choice of hierarchy of certain types of processing (mainly the running of conversations).

In order to keep the greatest portability and global nature of the description, the CODASYL(1) formalism is adopted. Its main concepts are the following:

RECORD
It is a given collection of n properties, each occurence of a similar record can be distinguished from the others by the values of its properties.

SET
It is a link on the given collection of two records one of which is called the owner and the other is the member.

Specific regulations establish how to proceed instantaneously to the transposal of the design description to the logical description, then the simple algorithms to increase optimisation.

3.1.3. Physical Level

It is the description for data of the automated Information System as it will be physically located with the help of a given SGBD and/or of traditional files.

The concepts and the formalisms are therefore selected physical systems, and the main objective will be to further optimize taking into consideration its means, and additionally taking special note of the problems related to paging, safety, etc.

Once again, it can be claimed that simple rules can efficiently lead to the transposal of the optimized logical description to a version of the basis of a physical description.

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(1) CODASYL (Conference on Data Systems Languages) is an informal and voluntary organisation whose members are involved in the design and development of technics and languages for data systems. Over sixty organisations (manufacturers, government agencies, etc.) are represented.

CODASYL is above all known for its design and development language for programming COBOL (Common Business Oriented Language).

3.2. Description of the processing

3.2.1. The Design Level

In so far as the description of the design level of the data was aimed at providing a meaning to each of the elements in a static view of the environment in which the firm was active, the description of the design level of the processing, on the other hand, was aimed at providing a dynamic outlook of the purpose of the activity.

The latter caters to the demands of the world outside the firm : the customers, the suppliers, the banks, the State, etc. but also the populations involved, especially the personnel and the production tools.

To organise a firm is first of all to define the laws which illustrate the reaction that a firm must have to methodologically face up to these demands : what should be done when a tool breaks down, what should be done when an order is received, etc.

With the constant use of the same example, the use of the procedure could provide an outline such as the following of the design description :

This outline of the models illustrates

- the EVENTS (or RESULTS) such as :
. the arrival of a package
. an identified order

- the SYNCHRONIZATION such as :
. a and b

- the OPERATIONS such as :
. the pre-stocking
. quality and quantity control

- a PROCEDURE such as :
. receiving the goods.

Two fundamental concepts are common to the three levels of description of processing :

. the EVENT (or the RESULT)
. the SYNCHRONIZATION

EVENT (or RESULT)
It is the actual fact, the sollicitation, whose existence provides the launching predetermined processing.

SYNCHRONIZATION
It represents the boolean condition which must be satisfied in the event of simultaneous accurence of several events which provokes the execution of a set of procedures for processing.

It represents a potential waiting point in time.

Ideally, the synchronization is, aside from being the illustration of waiting points, the means to eliminate the ambiguity of the figure with regards to the paths which could be followed depending on a given situation. Lastly, it would be possible, owing to additional concepts not mentionned here, to reach synchronization at given moments of phenomena each occuring asyncronously.

As is the custom, the events which occur at a synchronization are implicitly allocated the identifiers a,b,c, ... from left to right. The boolean expression registered in the synchronization can be illustrated thanks to the letters corresponding to the events involved. In the case where the boolean expression is only made of 'or', as well as in the case where there is a sole event with some incidence, the synchronization does not exist as such, but does for the sake of homogeounity of the graphic representation, and in this case a symbol is drawn with nothing written inside.

The two concepts directly linked to the level of description of the processing are :

. the OPERATION
. the PROCESS

OPERATION
It represents the set of processing which can occur independantly of a set of the same nature and without having to wait for a given point of its occurence to reach an additional event.

It can be said that it occurs without an external waiting point in time, which is obviously possible owing to the occurence of synchronizations formerly discussed.

The existence of this characteristic is essential in that without it, rigourous isolation and positioning phenomenas which occur in the organisation one with respect to the other would not be possible. Furthermore, the description of the operation as a structured set of management rules is thus possible.

PROCESS
The incorporation of such synchronized sets of operation within an invariable subset in a given field is possible, that is, the ones dealing with entrance and exit points which are stable events compared to the modifications which could alter the choice of management of the organisation.

SUMMARY

The design description of processing is a means to divide the activity of the firm into processes which are based on the events which are the basis of the activity itself ; each process being described as a synchronized set of operations, each being described as a structured set of management rules.
It reveals cycles, synchronizations, decision points, disregarding the means or the allocation of task by department or by work station, and in this way provides a basis for thought on the meaning of action undertaken by a firm.

3.2.2. Logical Level (or organisational)

It is the result of the refined description of the design level taking into consideration the choice of organisation, that is mainly the distribution of the application of the management regulations formerly defind between the men and the diffrent means for processing the information (conversational, postponed, centralised, decentralised).

This refining leads to further elaborating the description of the nature of events which initiate the process, which provide the variables of the events which correspond to the variables in the approaches adopted within a process, as well as the corresponding variables of the level of management regulations or of the results.

Each of these variables to the approach in the function of the nature of the events which are the initiators makes up the sub-set of a process and defines the concept of the procedure.

After having decided on certain options involving the distribution of the application of the management regulations, for each of the procedures, between different types of departments and work stations as well as between the men and types of means for processing the information, phases are thus identified.

PHASE

It is a process of management regulations which are consecutively accomplished within the same work station, and which become a logical concern in that, as long as the operation is not over, it is not possible to start this unit over again or any other similar unit.

To a given phase there is a corresponding type of unique distribution -or highly similar to the development- management regulations between men and machines. One phase can be applicable to several procedures in a given process.

A phase can be analysed by a set of tasks.

TASK

It is a sub-set of the operation described in the design level, this sub-set being accomplished
. by a work station
. either by "man" or by "machine".
Being guided by a similar synchronization formerly discussed in the design level, the task is also a set of detailed management rules which can be accomplished consecutively and without an external period of time.

The phase being a synchronized series of tasks, it can be noted that the procedure is a synchronized series of phases.

It is clear that the formalism used in the organisational level is the same as the one used in the superior level and that the concept it deals with repredent the refined version of what was formerly done, provided that the possibility of adopting several other operational solutions are left open : choice of material in a given type, programme sharing, etc.

3.2.3. Physical level (or operational)

It deals with the description of a system in order of sequencing ; it is the consequence of the organisational description in which a choice related to the material, the occurences of work stations, and the possibilities of task sharing in the programmes or conversations similar to several procedures have been integrated.

The concepts used are therefore more traditional as they are mainly :
. conversation and task in actual time for the semi-automated processing
. chain and unit of processing for the postponed processing.
Despite this fact, special attention has been given to determine the responsability of the resources, which is a logical way to follow through to the notion which is revealed in the definition of the concepts of the operation and the task, which can be carried out "without an external period of time". That is why, at the organisational level, the description includes the concept of :
. a segment of instructions.

SEGMENT OF INSTRUCTIONS
It is the sub-set of a task in actual time or of a unit of processing, that is a series of instructions which can be carried out without an external period of time most particularly as the shared resources which are needed.

Such a segment is therefore guided by an analogous synchronization which was described earlier.

Therefore, the formalism used throughout the three levels of description is the same and each description is a refinement of the preceeding one, integrating the choices which have become more and more technical and specific.

THE STRUCTURED SYSTEMS ANALYSIS AND DESIGN METHOD (SSADM)

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ABSTRACT

This paper summarises the views expressed in the author's address to the Data for Development and the State Economic Information Centre of China International Conference Plenary Session on Methodologies for Planning, Design and Implementation of Information Systems in Government. It describes the selection and establishment as part of the infrastructure of a the UK government's IT policy. It covers the processes of identifying SSADM as the best candidate for an embedded procedural standard for UK Government Administrative IT to its establishment as the UK's leading, and publicly available, systems analysis and design method. In the course of this paper, not only will the method's history be outlined, but current policies and plans for management, support and automated tools development will also be described.

1. WHAT IS SSADM ?

- SSADM is the acronym for the Structured Systems Analysis and Design Method.

- It is a comprehensive set of prescriptive standards :

    - structure, which define a set of tasks and the order in which they are undertaken;
    - techniques, how each task is to be carried out; and
    - documentation, which describes in detail how the results of each task are to be recorded and re-used.

- This set defines the procedures and techniques used by practitioners in the analysis of requirements for, and the subsequent design of, software systems for use in computers.

- In following SSADM, practitioners adopt a rigorous and unambiguous approach to determining specifications, and this provides, as output, a full definition of the software to be built.

- This paper will not describe the detail of this process, and the description may be found elsewhere (References 1, 2 and Figure 1)

- Because the method is so fully defined, it is ideally suited to computer support, and this aspect forms a major plank in UK Government's strategy for its future.

2. DEVELOPMENT OF THE METHOD

- CCTA's search for a standard method for IT system requirements analysis and design followed parliamentary concern that IT development in the Civil Service needed rigorous management. It was recognised that the size and complexity of government IT projects would increase rapidly in the course of the 1980s - a good example being the DHSS Operational Strategy series of projects for computerised coordination of whole person social security records, which is one of the largest projects in Europe.

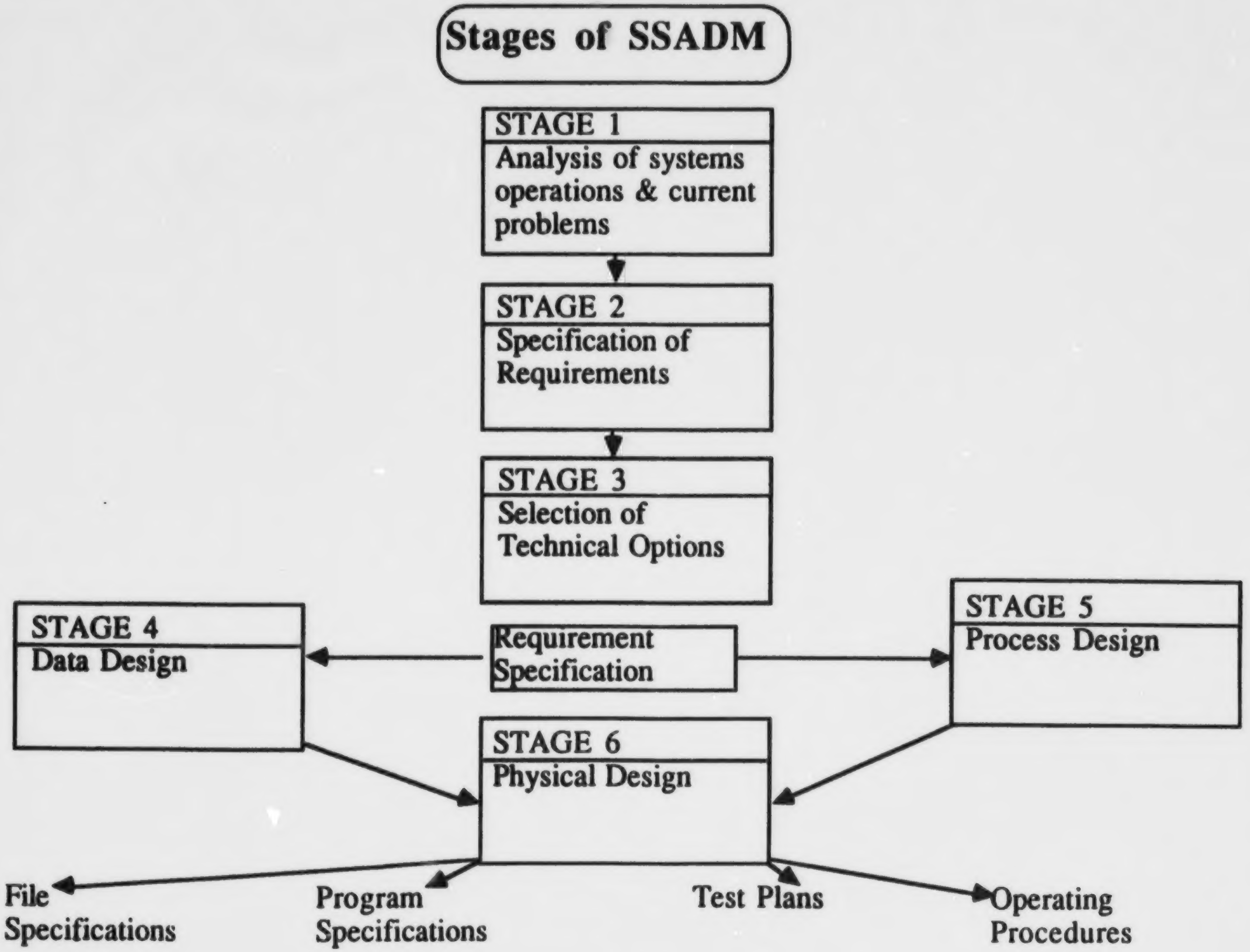
Stages of SSADM
STAGE 1
Analysis of systems operations & current problems
STAGE 2
Specification of Requirements
STAGE 3
Selection of Technical Options
STAGE 4
Data Design
Requirement Specification
STAGE 5
Process Design
STAGE 6
Physical Design
File Specifications
Program Specifications
Test Plans
Operating Procedures

Figure 1

- The first step was for CCTA to invite tenders in open competition and this resulted in some 40 responses from various suppliers from a range of companies from several nations.

- After exhaustive evaluation of these diverse proposals, UK Government selected the Logical Structured Design Method (LSDM) from Learmonth and Burchett Management Systems (LBMS). This method offered the best starting point for the government's own method. But there was a substantial number of ways in which this method did not fully meet the CCTA requirement. To correct these deficiencies, CCTA contracted with LBMS to undertake an extensive development programme. The results of this joint effort was the first version of SSADM. It has been the subject of on-going development, both with LBMS and many others.

3. INTRODUCING SSADM

3.1 Initial Takeup in UK Government

- In 1981 CCTA introduced Version 1 of the method on a trial and carefully managed basis. These early projects were supported by :
    - CCTA project support consultancy;
    - private sector consultancy from a small number of accredited companies; and
    - training courses from the Civil Service College and LBMS.

3.2 Consolidation

- Following this, the method was developed by CCTA to version 2.
    - Project support continued as before, but especial emphasis was placed on concentrating both CCTA and private sector consultants effort on :
    - installing the method on-site;
    - tackling the management issues of its introduction;
    - tailoring the method to the specific needs of projects; and
    - providing support for the quality assurance tasks prescribed by the method.

- By the time SSADM version 3 was developed, in 1985, there were estimated to be over 300 government projects which had used or were using SSADM. (See figure 2). Usage in the private sector was small, but is now beginning to increase rapidly.

- Since that time UK government has pulled back from direct project support to projects using the method, but it is now estimated that there are over 600 government projects which have used, or are using, SSADM. We believe there is an equivalent number of private sector projects with SSADM/LSDM experience. It is also used extensively now in other countries, including Australia, Portugal, Hong Kong and Zimbabwe, as well as the USA, where LSDM is promoted by LBMS.

Take-up of SSADM on Government Projects

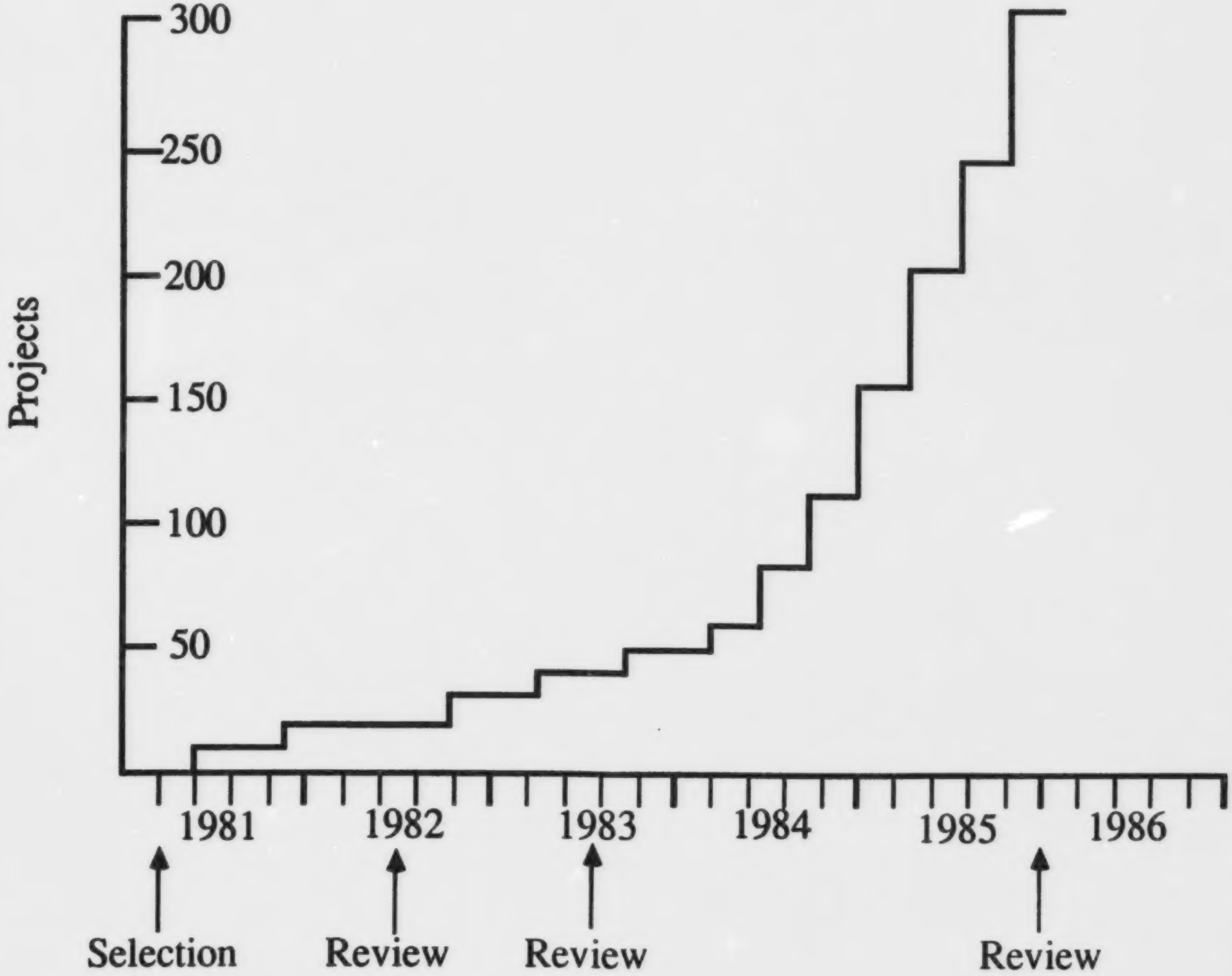

figure 2

4. THE MANAGEMENT OF SSADM

- Since pulling back from actively supporting government SSADM projects, CCTA has concentrated rather on the development and management of the method as a national policy issue.

- The method is now available to the private sector. CCTA remains the design authority but the National Computing Centre Ltd (NCC) now jointly administer it with us. It is now fully public and non-proprietary. It is free of charge to those who wish to use it. There is no licence for installing it, although of course, organisations wishing to will have to pay for the standard NCC documentation (#150) per copy, and for training courses and consultancy.

- We recognise our responsibility to manage its development effectively, and in a way which reduces to a mainimum the operational burden on users caused by necessary updates. The number of developers employing the method, and the diversity of their applications, is now so great that we shall from here on assist them further by adopting a properly planned release policy.

- To ensure ease of use, major releases will not normally be introduced more frequently than every two years, although as part of our quality programme some developers with experience may be asked to conduct trials of new techniques prior to their wider release.

- A change control board has been set up including members of CCTA, NCC, the British Computer Society (BCS) and the Computer Services Association (CSA).

- The UK government has applied for "SSADM" to be trademarked, so as to ensure the integrity of commercial services relating to it.

5. THE FUTURE OF SSADM

5.1 Short Term Developments

- SSADM is widely used for procurement, especially in turnkey projects. We are also about to introduce procurement standards which require 4GL and package suppliers to supply an SSADM "bridge".

- The CCTA and the NCC remain fully committed to the long term availability and development of SSADM, and in achieving this will take account of the need for it to remain "state of the art" and to comply with appropriate national and international standards. The need for improvements is identified from :

    - public demand and requests for enhancement from the SSADM user population; and

    - studies and research into the use of SSADM in new environments such as 4GL.

- The next version of SSADM will incorporate many substantial developments which have been inspired by these two routes. Before introducing any new technnique or document, the proposed developments are subjected to field trials and refined.

- Examples of these changes are techniques and support for dialogue and process design especially oriented to use with software led projects making use of 4GL technology, techniques for modelling distributed systems, and improvements in the way in which SSADM links to the disciplines of capacity management and performance prediction.

5.2 Medium-term Developments

- UK Government owns SSADM, and is committed to its long term development.

- Areas which are being studied now for incorporation into future versions of SSADM are :

    - support for problem domains other than typical administrative database oriented ADP applications. These will include, for example, real-time and expert systems

    - support for other processing paradigms such as object-orientation;

    - application in office automation system design; and

    - potentially, hardware specification.

5.3 Wider Developments

- CCTA is currently cooperating with its European colleagues to establish a pan-European Standard for Software Development based on widely used national standards such as MERISE and SSADM.

- UK Government is keen to participate in such an initiative because after 1992, intra-European trade barriers will be removed, and the expected results for European governments' IT strategies are :

    - award of contracts across national boundaries will be easier;

    - it will be easier to plan, develop and maintain large pan-European projects spanning Athens to Aberdeen, and Madrid to Munich.

- Such projects will require a common infrastructure, and "Method 92" will be a major plank of this framework.

6. SUPPORT

6.1 Policy

- CCTA currently underpins the method, but not its support.

- It looks to the private sector and other specialist organisations to provide these method infrastructure services.

- At present, there are 8-10 companies accredited to provide SSADM training, and about 50 to provide consultancy. CCTA wishes to encourage the growth of this marketplace, but without continuing to accredit individual organisations.

6.2 Training

- CCTA will maintain the quality of SSADM training both in and out of central government by an independent national system of accrediting training organisations and candidate practitioners through the British Computer Society and the national Systems Analysis Examination Board.

6.3 Consultancy

- The establishment of "SSADM" as a Certification Trade Mark will enable it to monitor the organisations offering "SSADM" suppport services. Organisations applying to use the mark will be required to demonstrate that they have the capability to fully comply with the standard set out in the official reference manual of SSADM. Furthermore, any organisation not continuing to comply with the current standard will lose its right to use the certification mark.

- In this way, the method will be publicly available with a high standard of competent support.

7 TOOLS

7.1 Policy on Tools

- The three views which SSADM take - data, process and time - allow extensive computer support and provide for extensive consistency checking. This was a major factor in the initial choice of SSADM. CCTA now builds tools on a non-commercial basis to determine how best to improve the method for tool purposes, and to provide a specification to which the private sector can build commercial tools. In this way CCTA is moving ahead with a strategy of making SSADM a computer-based method.

- There are two reasons for relying on the private sector to build tools :

    - they are geared up to high quality standards, such as IEEE 9000 and BSI 5750 for the production of such products; and

    - they are well able to raise the venture capital required for such developments provided they are assured of a substantial slice of the very large public sector market. (UK Government constitutes 20% 0f that UK domestic market, and therefore meeting the SSADM standard is an important attribute of any tool development likely to show an attractive rate of return.)

- One UK company is developing a tool to provide computer-based training.

7.2 Current requirement for tools development

- The current generation of tools present SSADM practitioners with opportunities to make use of graphics and text editors integrated with design databases. The most appropriate of these support the SSADM documentation standard. Some provide an element of support for the technical standard. There is minimal support for the structural standard of SSADM. To overcome this, and as a complement to the policies of the Certification Mark and SSADM accreditation by examination, CCTA has embarked on, with the NCC, a programme of certification of support tools for the support of SSADM. The factors to which especial weight is given are :-

    - implementation in the design database for the main components of a model of SSADM (figure 3);

    - appropriate support for the notation of the three main techniques of the method;

    - ability to produce a selective range of screen and paper-based cross-reference reports for catalogues of systems analysis information, and completeness and consistency checks;

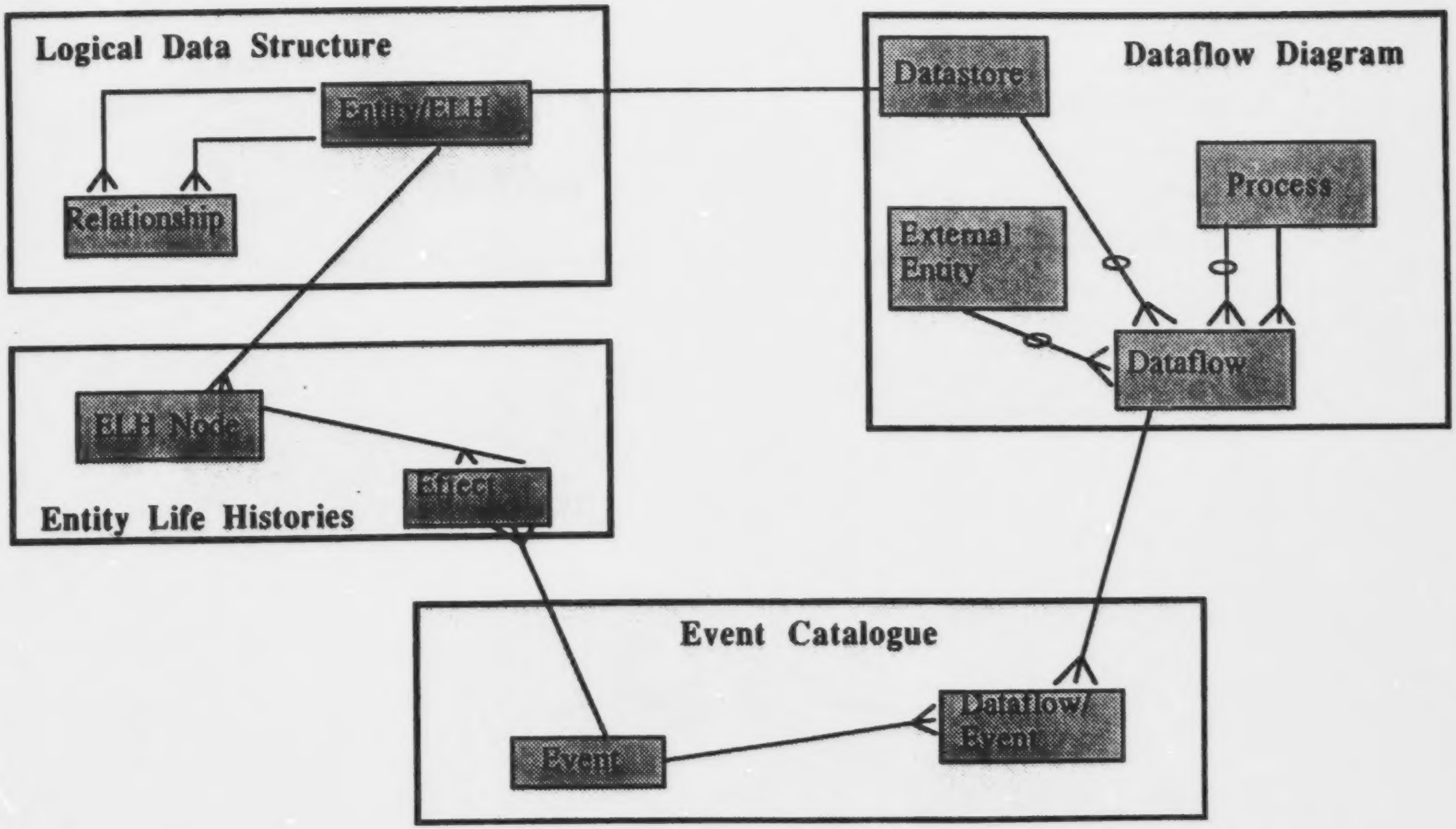
Logical Data Structure
Entity/ELH
Relationship
Dataflow Diagram
Datastore
Process
External Entity
Dataflow
Entity Life Histories
ELH Node
Effect
Event Catalogue
Event
Dataflow/ Event

Figure 3

  - potential to support team working;
  - document management and configuration control;and
  - quality and flexibility of the human-computer interface.

7.3 Future tools development

- We must all take advantage of rapidly developing technology and standards if the best quality computer support for methods practitioners is to become commonly available. Significant trends are in :
  - object oriented languages;
  - expert system development environments;
  - common tools interfaces;
  - WIMP and hypertext facilities; and
  - large screen graphics workstations with large onboard RAM, linked to networks with very high-speed, high capacity backing store, communicating with office systems and mainframes.
- Future advanced workstations will address wider support for the activities of the whole application life cycle, as well as providing deep support for the individual documentation, technical and structural aspects of each activity. The areas which our plans address include :
  - configuration and information resource management;
  - process logic definition and the links to 4GL;
  - support for formal notations for specification and the potential for mathematical proof; and
  - applications of expert systems in the proposition of solutions to data processing problems.

7.4 The SSADM Tools market

- There are currently 10 companies producing packages which can reasonably claim to support SSADM. There are many others producing tools which support other methods.
- The development of larger marketplaces, such as a pan-European one, will encourage the establishment of converging, or generic methods, and the provision of support tools capable of offering quality and productivity improvements to a wide range of techniques.
- The market is highly competitive, and the establishment of a wide range of tools prevents the risk of government lock-in to the products of one supplier, and competition helps to encourage better value for money.

8. CONCLUSION

- The many threads of IT are finding common ground as similar technologies (methods and tools designs) are aplied to different problem domains. In the case of automatic system construction, tools developers, 4GL developers and methods developers are working to the same goal by differing routes.

- And although short term benefits may accrue to users adopting a solution driven by a particular tool, it is only by concentrating on the method and its development that nations can establish an IT development infrastructure on a stable foundation to reduce risk, improve quality and widen opportunity.

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IDEA
A METHODOLOGY USED IN THE STRATEGIC PLANNING PRACTICE OF THE STATE ECONOMIC INFORMATION SYSTEM OF CHINA

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ABSTRACT

IDEA (Integrated Design Effort Approach) is a strategic planning methodology for large management information systems. It has been shaped over years in the practice of the State Economic Information System (SEIS) of China. This paper gives a brief introduction to the principles, tasks and main activities of IDEA.

1. INTRODUCTION

IDEA (Integrated Design Effort Approach) is a methodology which gives emphasis on strategic planning of large management information systems. It was gradually formed in the past years in practice of design and implementation of the State Economic Information System (SEIS) of China and its subsystems located in various areas.

The necessity to develop a complete methodology emphasising strategic planning for large management information systems stems from the fact that most existing IS design methodologies restrict themselves to dealing with EDP systems and rather small MIS systems in which strategic planning activities are simply replaced by the so-called "Feasibility Study" activities. There are some discussions concerning strategic planning activities for MIS (see references 1 - 10), but this research was aimed at different steps of strategic planning and there is no unified approach to analyse their different roles and their possible connection (reference 6).

A complete methodology depends on a morphological system of planning, design, implementation and maintenance of MIS which reflects and reveals orders and rules behind the complex design efforts. Such a morphological system should be built axiomatically, that is to say, theoretically but not experimentally only.

A two dimensional morphology (TDM) for MIS's design and development, based on Hall's systems engineering model (reference 11) is given in the paper (reference 12) which underlies IDEA.

TDM is a morphological system of methodologies for the whole life cycle of a management information system, while IDEA equips the strategic planning stage of TDM with details that include developments of concepts, choices of tools and algorithms, and connections of different logic steps. Then it is reasonable to briefly introduce TDM before we develop IDEA.

TDM is transformed from Hall's three dimensional morphology for system engineering by fixing the activity space at the point of the MIS field along the knowledge dimension and by retaining two other dimensions: time dimension and logic dimension. The important idea here is that no matter how diversified the different existing methodologies for MIS are, they, in the final analysis, develop in the time and logic dimensions.

TDM discussed the partition of time-axis in terms of the life cycle of MIS and then contents of the logic steps by using the Hill-Warfield model (13) as interlink between the Hall model and TDM.

The resultant TDM formulation is shown in Figure 1. Two comments should be made here.

(a) Figure 1 shows that for every time stage (strategic planning, project planning, system

Logic / Time	Problem definition	Value system design	Scheme synthesis	Scheme analysis	Optimization	Decision making	Planning for next stage
Strategic planning (Architecture design)							
Project planning (Application system design)							
Development of applications or other project							
Turn over system to user							
System operating and maintenance							
System renewal							

Fig. 1 Two dimentional morphology for MIS

development, turn over system to user, system operating and maintenance, system renewal, there are possibly (but not necessarily) seven logic activities (logic steps), that is, problem definition, value system design, scheme synthesis, scheme analysis, decision making and planning for the next stage. For a complete methodology, it should explore the possible and necessary content and tools of every logic step for different stages.

(b) The six stages on the time axis reflect the life cycle of a MIS and then are executed in a definite sequence. This is a task for methodology researchers to determine how to organise these logic steps so as to effectively solve the problems in every stage.

2. THE PRINCIPLE TASK AND MAIN ACTIVITIES OF IDEA

The explanation of MIS's design methodology means to reveal orders hidden behind complex design efforts and find efficient tools for realising the orders. Obeying the orders leads to gaining design goals effectively, and using proper tools raises efficiency of the design efforts. IDEA insists that orders dominate tools, that is, one can choose tool flexibility but should not violate the orders. Many existing methodologies have as their objective tool-choosing and omit order-finding.

IDEA is formulated for strategic planning of the huge State Economic Information System of China and its subsystems. SEIS is a social system engineering facing a shifting social and economic environment. China especially has been undertaking the Reform on Social and Economic Systems. IDEA noticed this critical factor and let itself go off the methodology category of "hard systems thinking", that is, in traditional system engineering activities one set of determined goals, then choose efficient tools to meet the goals, that is the "means - end scheme". IDEA exerts every effort to realise the "Soft system thinking", that is, one's "means" keeping changing with varying "ends".

IDEA is built on a basis of comparing and synthesising the existing methodologies concerning strategic planning of MIS (14) such as the methods and methodologies in papers (1) - (10).

In short, the above mentioned principles make IDEA serve as a framework of ideas and allow us to develop more reasonable methodologies by using it.

The task of IDEA is to provide competent authorities and engineering and technical personnel of the concerned system with a "blueprint" or architecture of the required MIS. It includes the following subtasks:

- determine the boundary and environment of the system

- investigate constraints and restrictions of the system development and corresponding strategies and policies

- design objectives of the system

- determine the integrate conceptual model of the system

- investigate information requirements and design logic architecture of the system

- break down the logic architecture into sub-systems by using suitable methods

- physical design (equipment planning)

- determine follow-up projects and pilot subsystems.

A "blueprint" with above contents will be used as a basis to guarantee the coordination of the system construction process and then the possibility of the integrity of the future system.

In paper (12) design activities in the strategic planning stage were transformed from the seven logic activities and their organisation in terms of time sequence was discussed. The main activities of IDEA are as follows:

- investigations
- objective design (including conceptual model design)
- analysis of information requirement
- logic architecture design
- planning for follow-up projects
- review and decision-making.

In the remainder of the article we will give descriptions of these activities with emphasis on objective design, information requirements analysis and logic architecture design. (For details see (15)).

3. INVESTIGATIONS

Level 1. Investigation of goals, missions and development strategies of the organisation who plan to have a management information system; determination of boundary of the organisation and description of organisational structure.

Level 2. Determination of main managerial tasks of the organisation in terms of the three managerial levels defined by R.N. Anthony (16); investigation of corresponding information requirements for these managerial tasks; the environment investigation.

The relationship between Level 1 and Level 2 of the investigation and other design activities is shown in Figure 2.

IDEA specifies investigation methods and provides six investigation forms to cover the above-mentioned investigation contents. IDEA also synthesises experiences so far gained in the investigation practice of SEIS.

4. OBJECTIVE DESIGN

What is a definition of the term "Objectives of a MIS"? It is not consistent with many existing methodologies. Many (2), (6) consider theoretically that objective design gives objectives, constraints and strategies. But in practice, if given several design groups with different backgrounds working at a same system, they may appear different-looking on system objectives that would distribute from abstractive and inspiring ones to detailed performance objectives. In fact, it is natural to have this happen because people at different positions often look at the system from various points of view. However there is a need to have a framework to unify these different objectives.

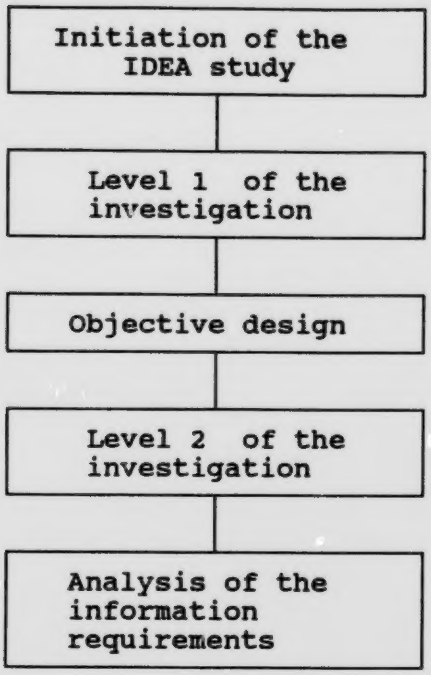
Initiation of the IDEA study
Level 1 of the investigation
Objective design
Level 2 of the investigation
Analysis of the information requirements

Fig. 2 the connection of investigation

IDEA suggests a multi-level structure to present an objective system. It has the following properties:

a) Objectives in various levels may belong to different categories but the objectives at every level except the top level are decompositions of the higher level objectives in some specified categories.

b) The decomposition of objectives to the next level according to some specified categories does not lose the integral supportance, that is, performance and realisation of the lower level objectives will guarantee the realisation of a high level objective.

c) The number of levels and categories should be designed to correspond to those important design steps, especially the steps in the strategic planning, so that the objective system (i.e. the objective design) will dominate and direct the whole design effort. In many existing methodologies, objective design seems to be separated from other design activities.

A multi-level structure used to analyse the objectives of SEIS is shown in Figure 3. Figure 3 also shows how the objective design will support other design activities.

IDEA discussed activities that help objectives transformed from one level to the next:

	Level 1 : the initial investigation
Level 1	Level 2 : analyse strategic tasks of the organisation and transform it into strategic tasks of IS
Level 2	Level 3: design and investigation of the managerial function objectives of the organisation that IS should support
Level 3	Level 4 : analysis of the environment
Level 4	Level 5 : giving evaluating system

This process is really an extension of King's (reference 2) strategic set transformation method.

At the end of objective design a conceptual model (CM) of the IS will be presented. A CM of SEIS answers the question : "What is the SEIS and what is it like?" A conceptual model sometimes is understood as a federation of functional opponents (reference 17, p45). In our understanding, for large MIS, CM is a federation of strategic components. Here strategic components are equal to the parts of the system which fulfill the strategic tasks independently or they are partitioned by high ranking privilege factors.

A CM is presented in detail by synthesizing the objective design results and gaining further insight into them as follows:

a) A CM does not simply and separately reflect the system's boundary, strategic tasks and managerial function objectives, but describes further and deeper connections of these elements in the meaning of integration. The connections mentioned here do not mean the data dependance relation but the relationship of the strategic elements identified in the research activities "analysis of the strategic tasks of the organisation" and "Design and investigation of the managerial function objectives". In objective design, data dependance relation is less important, but in logic architecture design it is a dominant relationship as we will show below.

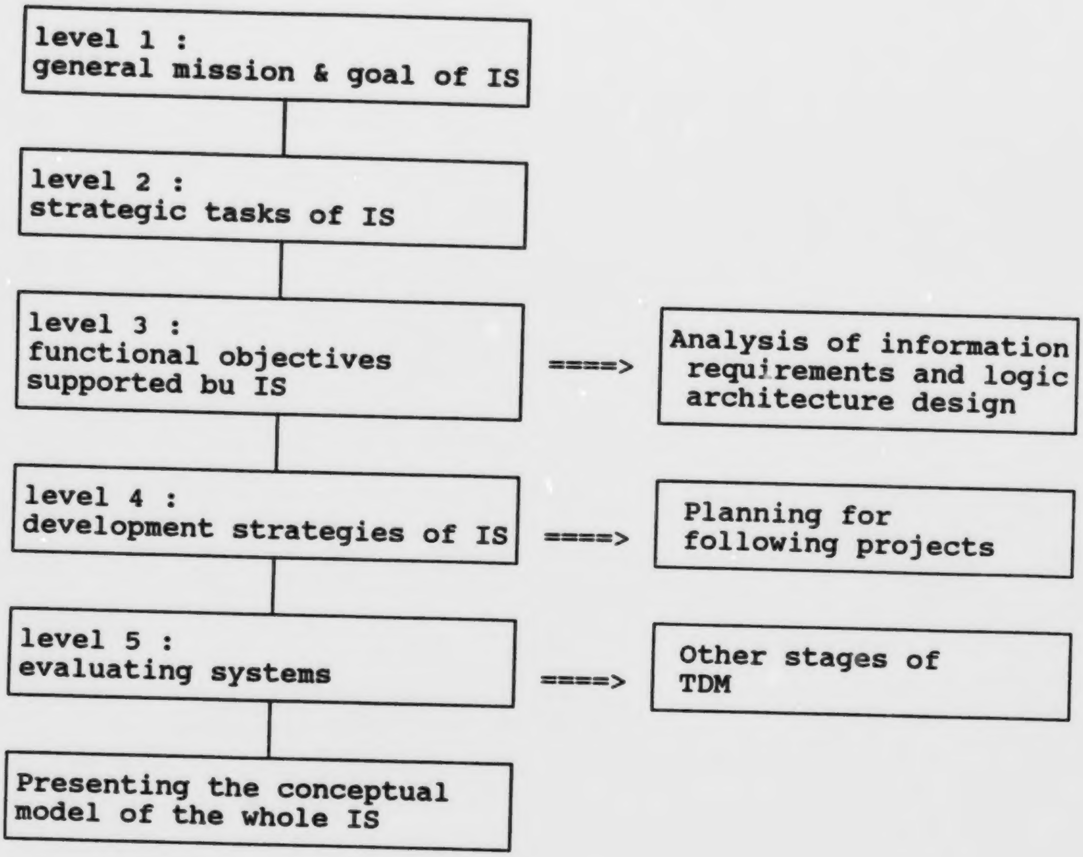
level 1 :
general mission & goal of IS
level 2 :
strategic tasks of IS
level 3 :
functional objectives supported bu IS
====>
Analysis of information requirements and logic architecture design
level 4 :
development strategies of IS
====>
Planning for following projects
level 5 :
evaluating systems
====>
Other stages of TDM
Presenting the conceptual model of the whole IS

Fig. 3 Objectives system

b) CM is a vehicle to dovetail the logic architecture design with the objective design. It gives general requirements to logic architecture design. For very large management information systems it is difficult to obtain the whole logic architecture that reflects all relationships of the data in a system in one design effort. The CM will suggest how to partition the system into several components in which we can do logic architecture design rather easily.

5. ANALYSIS OF INFORMATION REQUIREMENTS

Having the investigation materials and the organisational managerial function objectives, the next step is to set up the Managerial Function Model (MFM) and the process/data class matrix. These are main tasks in the step of analysis of information requirements.

A MFM is a forest structure as shown in Figure 4. At the roots of the forest are the managerial function objectives given by the objective design; at the successive leaf levels are subfunctions decomposed from the father leaf by applying some managerial theory or experiences; at the end leaves are very basic functions ... managerial processes. Managerial processes are defined as groups of logically related decisions and activities required to manage a relatively independent managerial function.

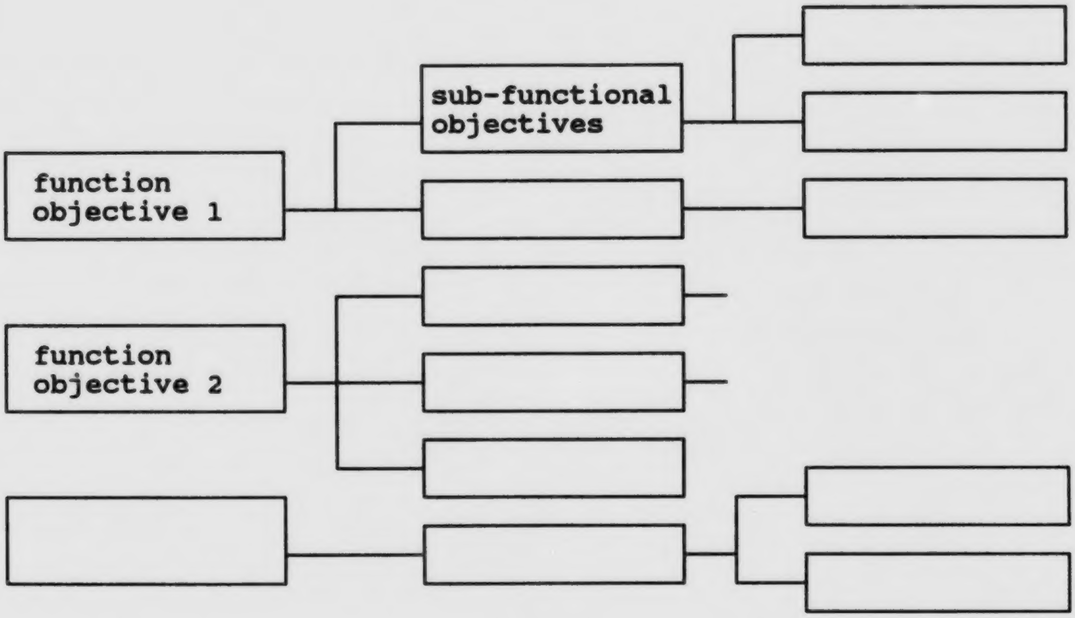

Fig. 4 Managerial function model

A very important idea is to identify which managerial processes need to be supported by the MIS, or say, need to be computerised and how to be supported from the managerial process given by the

MFM MIS designers. A part of the MIS which supports a managerial process is then called an information processing process, or simply a process. Such a part of the MIS may be regarded as a candidate of a subsystem. In (15) we discussed how to set up MFM effectively. Usually managerial theory provides an insight into effective decompositions for the higher levels of MFM while the information requirement investigation materials gained in Section 3 provide an insight into the decompositions for lower levels of MFM.

The reason for defining the processes is that in doing so, it leads to:

- an IS that is largely independent of organisational changes
- a basis for defining required information architecture, determining its scope, making it modular, and setting priorities for its development
- a basis for defining key data requirements.

Once the processes that support the managerial function objectives have been identified, the next step is be to identify and classify the data created, controlled, and used by these processes. That is, a data class is a category of logically related data that is necessary to support the managerial objectives, in other words, is used or created by a process.

The relationship between the group of processes and the group of data classes is described by a matrix - Process/Data class Matrix as in many methodologies (4), as is shown in Figure 5.

For such a very large system as SEIS, we are not able to use one matrix to represent all the relationships of all the processes and data classes. Furthermore it is also not necessary to draw all information in one picture.

In this case we can take the suggestion given by the CM and give the process/data class matrix separately for every strategic component of the CM. In our practice the state-level part of the SEIS is researched first as an important component of the whole system. It consists in about 508 processes and 931 data classes.

6. LOGICAL ARCHITECTURE DESIGN

Having acquired an understanding of the information requirements, that is, the processes and the data required to support them and their relationships, we should continue our analysis by determining how the data will be effectively managed to support the processes. The data classes that have been defined can be logically grouped into data bases. Correspondingly, processes can be grouped as application systems or subsystems. Both then formulate useful management information architecture to support the managerial function objectives.

IDEA gives a clue to choose suitable methods to fulfill this job in different cases. Among others, BSP (Business System Planning) is a typical method used in IDEA for a case that the processes cover comparatively complete life cycle of managing resources that support the managerial objectives (reference 14).

By using the process/data class matrix to start and rearrange the columns and rows, one gains a new matrix by grouping together those processes and data classes that have close data dependence relations. These processes will form the main systems of the architecture, while the corresponding groups of data classes suggest logical boundaries of Data Bases. The next step is to show the data flow from one system to the other. Finally, we have a logical architecture as shown in Figure 6.

Data classes / Processes	Data class 1	data class 2	3	4	5	6	7
process 1	C	U			U		
process 2		C		U			
process 3	U		C				U
process 4		U		C		U	
process 5	U				C		
process 6		U	U			C	C

Fig. 5 Process / Data class matrix

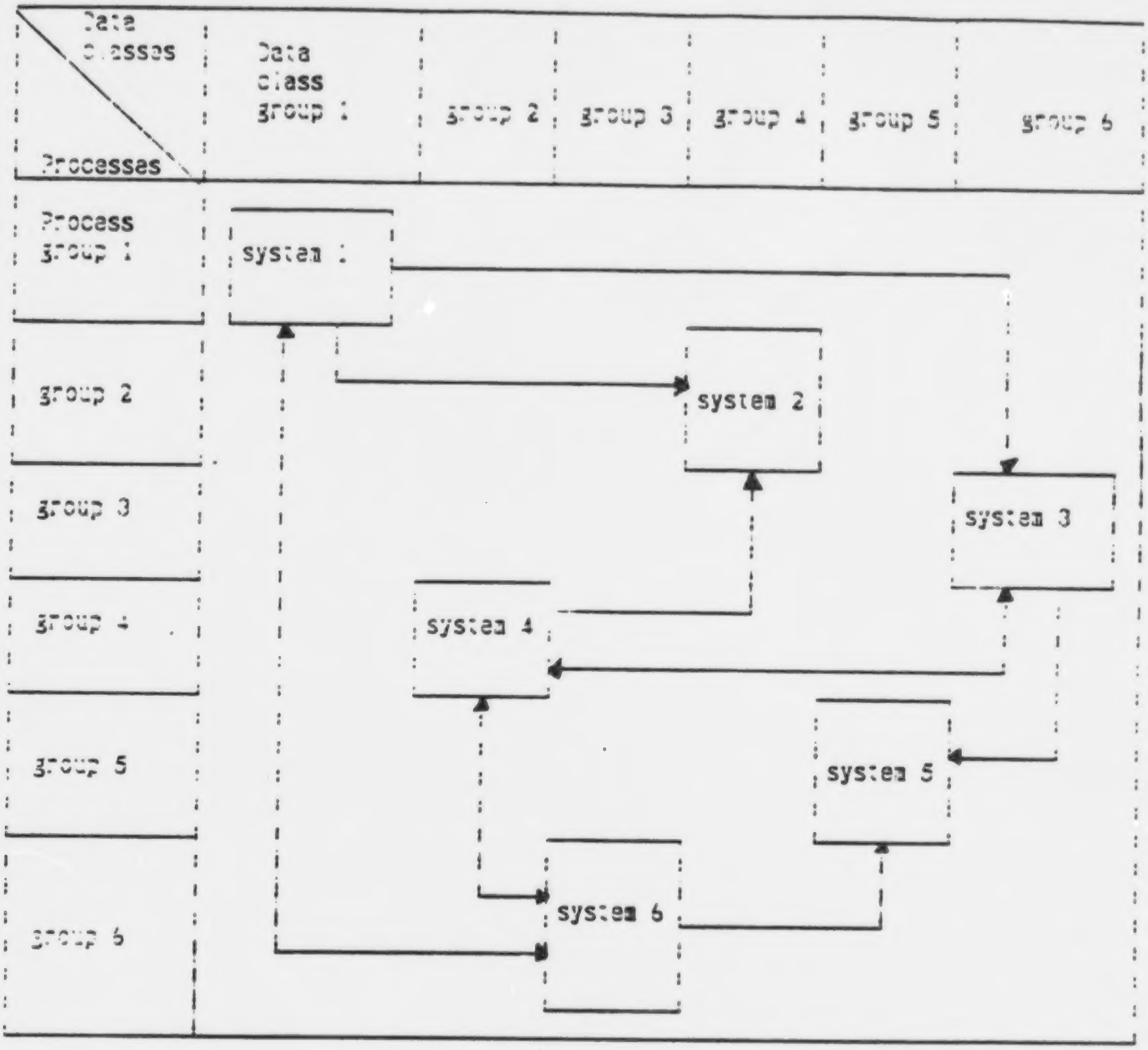
Data classes
Processes
Data class group 1
group 2
group 3
group 4
group 5
group 6
Process group 1
group 2
group 3
group 4
group 5
group 6
system 1
system 2
system 3
system 4
system 5
system 6

Fig. 6 Logical architecture of a MIS

For large matrix with more than 100 processes and data classes, K.E. Mansan suggested a graphic theory-based algorithm (18) to solve the problem. IDEA uses it as a computer-aided design software.

7. PHYSICAL ARCHITECTURE DESIGN

Based on the logical architecture and the system development strategies the designer now has to tell how to realise the "blueprint". That is, they should sketch out a plan for computer resources gaining and communication equipment purchasing and a physical architecture to direct the installation of equipment. Referring to the methods for physical architecture design, i.e. choosing an optimal physical architecture to fit the logical architecture and the development strategies, we find that there is nearly a barren area for this in the MIS design methodology literature.

8. CONCLUSIONS

IDEA has been used in the strategic planning of SEIS and its subsystems such as provincial economic information systems. It provides system designers with different knowledge background with a common design language and a useful framework to make the designer able to think. To do well in the complex design efforts, IDEA believes that to do right things is more important than to do the things right.

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COMPARING SYSTEM DESIGN METHODOLOGIES

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(*) This paper was not presented to the participants at the plenary session, owing to the fact that Mr. Williams was unable to attend the conference.

I. INTRODUCTION

1.1 Purpose

The purpose of this paper is to provide a framework for comparing system design methodologies. The paper is divided into three major parts. The first part presents some definitions that are used operationally in the second part. The second part provides the dimensions that a design methodology should include if it is to be considered comprehensive, complete, efficient and effective. The third part utilizes the dimensions presented in part two to characterize five (5) popular methodologies and methods in use today.

1.2 Background

A very simplified view of the system design process is that it consists of three basic activities: the identification of a need or problem, the development of a solution and the implementation of the solution. The need or problem may consist of a complex domain of entities, attributes and relationships that are not well articulated by any single individual or, in some cases, any single organization. A large financial system that integrates all the relevant business functions is an example of such a problem domain.

The set of requirements that will act as the baseline or benchmark for designing a system must frequently be extracted from an ill-defined statement of an information system need. A set of requirements specifications must be formulated that states the desired functional and performance characteristics of system components independent of how they will be realized. As Yeh(1) and others have shown, requirements are of two general types: functional and constraints. Functional requirements capture the characteristics of the interactions of each system entity with its environment.

The constraints restrict the types of designs that might be considered. The construction of functional requirements involves building a conceptual model of each system component in terms of its internal states and its behavior relative to other system components. The numbers and types of dependent relationships among functional components and the system environment defines the logical complexity of the system. Design complexity is also a function of the non-functional constraint requirements. A constraint such as 99.9 percent accuracy may raise the level of effort associated with its design and testing so high that it is unaffordable. Constraints are quite diverse and difficult to formalize. These include interface constraints, performance constraints, operating constraints, life cycle constraints, economic constraints and political constraints.

A designer must formalize and verify the system requirements. This requires that the designer map the user needs and expectations into a formal set of requirement specifications that account for all relevant entities, attributes and relationships that directly and indirectly impact the functional and constraint requirements. These requirements must be represented in such a manner phases and be tested for consistency and completeness. This will eliminate the error of the third kind: solving the wrong problem.

Based upon the requirements specifications, which should be a written document, additional phases of the design process can occur. The phases of the design and development processes plus operation and maintenance is referred to as the life cycle of a system.

This life cycle has been characterized as a linear model, waterfall model, a spiral model as well as others. Each phase in the cycle requires some representation of what needs to be done in the next phase as well as what was done in the current phase. The typical phases in the life cycle of a system are:

a. Need or problem conception
b. Requirements specification
c. Feasibility analysis
d. Design
e. Development/Implementation
f. Installation
g. Operation
h. Maintenance

In the past, major emphasis was placed on the development phase where structured programming, configuration management, interface specifications, verification, validation, testing, tracing, binding, coupling, span of control, modularity, reusability, metrics, and other software issues. This provided many valuable concepts and techniques that improved the quality of programming.

On the other hand, the resulting systems still lacked completeness, reliability, ease of maintenance and congruence with the requirements as well as not meeting estimated completion times and cost estimates.

Although additional research on the software development phase will improve reliability and ease of maintenance as well as reduce the error in time and cost estimates, it is unlikely to improve the lack of completeness and failure to meet specifications.

This was recognized by Cotter(2) who stated

"that a well structured implementation of a poorly designed system yielded few benefits ... A well designed solution to a poorly understood problem provided few rewards."

This would lead us to believe that some of the problems with system design lies prior to the development phase but is not separable from it. Over the past few years, a high level of attention has been given to research and the development of techniques and tools to support the requirements definition and design phases. This has resulted in a set of methodologies that provide a better understanding of the problem that needs to be solved, the context of the problem, the boundary conditions but most importantly better means for representing the requirements and the design. Many of the concepts fromstructured software development have been applied to the requirements specification and design phases. This includes decomposition methods, specification languages, design strategies, graphical representations, validation, verification, quality control, documentation, data dictionaries and a variety of automated tools. PSL/PSA is an example of a computer aided technique for structured requirements for an information processing system. The problem statement language is based upon a general model of an information system and provided analysts with the ability to describe a proposed system in a formalized and analyzable manner. It is based upon an object oriented view where objects have properties (attributes), property values (attribute values) and are related (relationships). The system description may be divided into 8 major aspects:

a. Input/output flow
b. System structure
c. Data structure
d. Data derivation
e. System size and volume
f. System dynamics
g. System properties
h. Project management

This data is maintained in a database for analysis and reporting. The problem statement analyzer uses the database to produce a series of reports including:

a. Modifications to database
b. Reference on objects, properties, etc.
c. Analysis on information flow, processes, objects, etc.
d. Summary reports and graphical representations

PSL/PSA is an example of an attempt to eliminate some of the deficiencies in representing complex system documentation such as ambiguity, inconsistency and incompleteness.(3) The Software Requirements Engineering Methodology (SREM) with its Requirements Statement Language (RSL) and the Requirements Engineering and Validation System (REVS) is an integrated set of tools to support the development of requirements. A relational database is a primary feature of the SREM system. The RSL statementsinput to REVS are analyzed and checked for syntactic and semantic correctness before being added to the Abstract System Semantic Model Database (AASM). The AASM maintains information on requirements and the concepts used to express the requirements. An RNET graphics tool is available to provide flow specifications. A simulator uses the AASM representations to produce Pascal code.(4) These systems attempt to structure the requirements specifications by integrating a set of tools that permit representing the requirements in a structured and computer processible form.

Once a set of requirements has been specified and accepted as complete at a specific point in time based upon current knowledge of the proposed system or desired problem solution, the formal design process may begin. In an unstructured approach, this generally develops in a many layered process that tends to fluctuate between highly abstract representations to finely detailed representations. The design methodologies attempt to bring discipline to this process. A very popular approach is to use a top-down method with decomposition and successive refinement as the underlying principles. These approaches tend to force a hierarchically structured system although some can handle network types of structures. The objective of the design phase of system development is to take the requirements which should clearly state "what" the system should do and the "constraints" under which it should do it and provide a representation of how the system should satisfy the requirements. Design should consider all the feasible alternative structural relationships among hardware, software, data and humans for accomplishing the requirements. Design is the process of recognizing feasible configurations of system entities and selecting those that will accomplish the requirements in a cost effective manner. This includes overall system design, module design, interface design, data structure design, database design, test design, procedure design, documentation design, training method design, etc. Most methodologies concentrate on the software design aspects. Methodologies such as Jackson structure diagrams, Warnier-Orr diagrams, HIPO, SADT as well as tools such as Data Flow Diagrams (DFD), data dictionaries and structured process specification are examples of approaches to designing software for systems. These are supplemented by design methodologies for database management systems (attribute synthesis, ER diagrams), dialog design, display design, forms design and others. The results of using these tools, methods and methodologies is a system design document representing such things as: how the system should be structured, how data enters the system and flows through? How data should be structured and stored in the system? How functions will be performed? What software modules are required?, the module interface specifications, pseudocode, I/O interfaces, user interfaces, testing plans, test cases and quality assurance for coding. These will be represented in a variety of forms and formats by different methodologies and tools. Diagrammatic methods of representation are very popular as well as tabular and matrix representations. Structured languages and formal mathematically based representations are becoming more popular as we learn more about relationships and attributes of the entities involved in design. The need for prose explanations and descriptions still exists. These representations of the design are the raw material for the development/implementation phase. The design specifications must be transformed into computer programs or problem descriptions used by computer programs (4GLs) that implement the design. It is important that the programmingpersonnel understand the intensional aspects of the design specifications. The design specifications should be verified against the requirements specifications for completeness and accuracy. Additionally, the design specifications should be internally consistent and accurate. Likewise, the computer programs, procedures and descriptions produced to implement the design should be verified, validated and tested against the design specifications. Methodologies are oriented in one of several ways:

1. Product oriented - support the definition of the products for a system but not specifically how to produce the products.

2. Object oriented - object oriented emphasizing the functionality of the system as a model of the real world.

3. Data structuring - emphasizes the structure of data to be processed and the composition of processing steps required for the data transformations.

4. Prototyping - used to clarify the requirements and the intended implementations based upon a "mockup" of the system as subsystem. Typically used to support product oriented methodologies.

A complete methodology must fulfill three major concerns:

1. Assure that the system fulfills its intended role,

2. Assure that the system meets its current specifications,

3. Assure that the system can be modified to meet changing requirements and to correct errors(5).

There are a number of tools and methodologies proposed in the literature and commercially available. There are those who are currently developing new methodologies and tools and there are those who need to use a methodology to implement a system. What features should a methodology have, what tools should it provide and what factors might be considered as evaluation criteria for selecting a methodology? The following sections of this paper will discuss issues relating to these questions.

2. DEFINITIONS

As a basis for the next section on the dimensions of a design methodology or method this section presents some operational definitions to aid the reader in understanding how several important terms are utilized.

Method - a specific set of rules and guidelines for executing the activities and processes necessary to utilize a technique. It serves as a vehicle to acquire, analyze, organize and interpret information related to a system.

Methodology - a collection of methods for performing all or a portion of the activities required to design a system. It provides a philosophy and general principles, practices and procedures that guides the application of the specific methods included.

Tool - a facility that implements a method or some part of a method.

System Life Cycle - the phases that a system passes through beginning with its birth as a concept to its death or rebirth. This includes conception, requirements definition, requirements specification, feasibility study, design specification, software development, testing, validation, verification, operation, evaluation and maintenance.

System Design - includes all activities related to the system life cycle including analysis. This is a shortened term for systems analysis and design.

Structure - the patterns of organization that depict how a system is constructed and how its constituent parts are related to each other.

Flow - depicts how data or sequences of transformations or operations occur in a system.

Mechanisms - those entities (hardware, software, people, communication circuits) which are responsible for various functions within a system.

Function - a set of actions, tasks, procedures or transformations that work together to achieve a specific objective of the system.

Procedure - a series of steps followed in a regular and definite order.

User Interface - the protocol and the mechanical and sensory interaction between human operators and the system.

Program Module Interface - the set of arguments, common areas, procedures or other objects, that are passed between two program modules.

Distributed System - a system wherein processing and/or data is not centralized but is located in geographical, separate locations.

3. DIMENSIONS OF SYSTEM DESIGN METHODOLOGIES AND METHODS

3.1 Structural Dimensions

As the current trend in systems analysis and design would indicate, structural dimensions are a critical aspect of the representations necessary for analysis, design, implementation, operation and maintenance. Cotter has identified four basic structural dimensions: (1) general structure, (2) data flow structure, 3) data structure and (4) control structure.(6)

3.1.1 General Structure

The general structure of a system must show how all the system components are related. This must be done at varying levels of detail and it would be desireable to represent the system from various viewpoints. The methods used to represent the general structure should be able to represent the current system as depicted by the analysis, the proposed system(s) as depicted by a feasibility study and the requirement specifications, the design as a result of the design process, the implementation in terms of software packages, the operation in terms of training manuals, users manuals and maintenance in terms of documentation and program libraries.

Research has shown that humans deal most efficiently with hierarchical structures and most of the methodologies use hierarchical structures to represent the general and other structural dimensions of a system. Not every structural aspect of a system is hierarchical in nature. Some relationships are network, threaded, etc. which either lose their meaning or increase in complexity when represented hierarchically. It would be ideal to permit both hierarchical as well as non-hierarchical structures to be represented. Guidelines for dealing with levels of detail should specify when general structural characteristics end and other structural characteristics begin. The general structural dimension should be derived directly from the requirements specifications, design specifications, and implementation documentation. It should support graphical representations as well as specification language descriptions.

3.1.2 Data Flow Structures

It may seem strange to include data flow under structural dimensions but the definition of structure (made up of interdependent parts in a definite pattern of organization) clearly makes data objects and the pattern of flows through various transformations a structural dimension. Like other structural dimensions data flows may be represented hierarchically with each level in the hierarchy representing lower levels of detail until the data object primitives and/or transformation primitives that match the requirement specifications are obtained. A complete method of data flow diagrams (DFDs) has been developed. DFD should be supported by a data dictionary that represents the data objects in a system, the relationships that exist among the data objects in a system, the relationships that exist among the data objects including inheritance and other aspects related to the system and its data. Traditionally, DFD methods represent data with labeled vectors that join a transformation represented by a bubble. Other symbols represent data stores, etc. Transformations are decimally numbered to cross reference lower level transformations showing details not shown at higher levels. Construction of DFDs forces identification of inputs, outputs and the processes that transform inputs to outputs. DFDs permit high levels of abstraction and support the notion of functional decomposition and successive refinement. Flow representations have always been important beginning with the system flowchart or block diagram at a general level and the detailed flowchart at a lower level. The problem with these tools are that they attempt to represent all the structural dimensions as well as procedural dimensions bring a using approach with few guidelines for the individual generating the flowchart or for the individual attempting to read it.

Flowcharts had a standardized set of symbols that were intended to be used unambiguously but did not always communicate what was intended.

Every system has data flow consideration. Financial and economic systems have complex data flows that must be represented, validated against the requirements and utilized in the design and implementation process.

3.1.3 Data Structure

The analysis and subsequent design of a system must be capable of representing the complex relationships that exist among data objects in a system. DFDs show the flow of data through a system and transformations at various steps in the flow but do not reveal the internal structures of data stores, displays, reports or complex data objects. Nor do they show the sequence of transformations or temporal aspects such as concurrent processing. During the analysis phase this is important for determining performance constraints such as storage capacity, number of I/O accesses, access methods, access keys, sorting requirements, indexing requirements, channel capacity, circuit capacity, buffer requirements, blocking factors, primary memory needs and computing related to I/O and data structure maintenance. Data structures affect the flexibility, maintainability, extendability as well as the efficiency and effectiveness of a system. A data structure relates data objects that must be transformed in a variety of ways to support the system requirements. Generally, more than one data structure can be used but with different efficiency and effectiveness results. Quantitative measures that verify that a data structure satisfies the systems functional requirements to some degree as well as the non-functional requirements (performance) at some level is desirable. Several database design techniques attempt to provide methods of computing logical record accesses based on entity relationships across functional views of a system. Attribute synthesis is also a method for structuring data relationships. It should be noted that Jackson and others believe that the structure of a problem is reflected in the structure of its data and this structure guides the solution to the problem. In this context data structure does not refer to queues, trees, etc. but to data transformations and their sequences.(7)

3.1.4 Control Structures

Control structures characterize the overall procedural aspects of a system, subsystem or module. Control structures occur at all levels within a system and are useful for a variety of purposes such as module construction, analysis of a function, evaluation of a system, configuration management and system management. Although the most specific case for control structures is at the program module level via sequence, selection and iteration, these same structures are applicable at higher levels of abstraction as well. Issues related to control structures at an architectural or functional level are span of control and scope of effect. At lower levels such as the module interface and content level issues such as coupling and cohesion are important characteristics.

3.2 Level of Analysis and Design

Requirements analysis, design and implementation occur at several levels. The design methodology should accommodate all these levels. Requirements analysis occurs at two levels: the requirements definition level and the requirements specification level. Design occurs at the systems level and the program level. The systems level includes a conceptual design and a technical design level. Within each of these, various levels of abstraction must be accommodated. Program design occurs with several levels beginning with program specifications followed by different representations of the program logic using flowcharts, pseudocode, structured English, Nassi-Shneiderman charts and other such methods.

3.2.1 Requirements Definition

This level of analysis is one that specifies what the system must do in terms of functions, data flows, interfaces, inputs, outputs, transformation, sequences, etc. and the constraints under which it must meet the requirements. But it must state these functional and non-functional requirements in terms at a level of abstraction that the user or customer can readily understand. This level of representation must present the requirements using langauge and other notations that do not require hardware or software expertise on the part of the user but must be capable of unambiguous translation into a requirements representation that should be verifiable in terms of consistency, accuracy and completeness. Natural langauge is an obvious choice for the user but is difficult for the system designer. A subset of natural language is an obvious choice.

3.2.2 Requirements Specifications

This level of representation specifies in technical terms the system requirements. These must represent a complete and accurate representation of the requirements definition. This should include both functional and non-functional requirements. This level should act as the baseline for design with analyzability and traceability features. Several methodologies have defined formal languages for this level including PSA/PSL, SREM/RSL, GIST as well as others.

3.2.3 Conceptual Design

This level of representation of design presents a high level of abstraction for the proposed solution(s) in terms of how the proposed solution(s) will address the requirements specification and can act as a basis for the technical design specifications and determining feasibility from economic, technical and operational viewpoints. This is where alternative solutions can be explored. This is a structuring process which begins to determine the architecture of the system and the clarification of mechanisms for meeting the requirements. Some systems can be characterized as function-strong while others can be characterized as data-strong. Within each of these classes there may be time dependent sequences and parallel processing requirements. The choice of a hierarchical or network representation may be of critical importance in accurately representing requirements and their relationships. Many techniques such as functional decomposition, successive refinement and information hiding are used at this level. Design strategies are important in terms of top-down, bottom-up, data driven, function driven and others. Representations such as context level, DFDs, actigrams, datagrams, system flows, visual table of contents, IPO charts, design specification languages and others may be utilized. It should be possible to trace representations and to analyze them for consistency, completeness and accuracy. Natural language is the easiest for the non-technical people but is not satisfactory for technical design.

3.2.4 Technical Design Specifications

The technical design specifications operate at a low level of abstraction and translate the conceptual design into a representation that can be utilized to directly design program modules. This level of representation must include functional, data flow, procedural detail, I/O detail, interface detail and structural detail. Representations at this level include lower level IPO charts, record and display formats, structure charts, flow charts, low level DFDs, prototypes, design languages, etc. Design strategies may include decomposition (top-down), composition (bottom-up), data oriented, function oriented, transaction oriented or others. Most of the methodologies are strong in the technical design areas but tend to take different approaches to the problem. Jackson's structured methods and Warnier/Orr methods tend to be data strong methods while SADT and structured analysis and structured design tend to be function strong methods. The technical design specifications must be validated against the requirements and must provide the information required for program design.

3.2.5 Program Module Design

Program module design defines each module within a system and the intermodule interfaces so that each module of the system design. This should describe data types, algorithms, module types (interruptable, incremental, re-entrant), sequence, selection and iteration, flow diagrams, pseudocode, structured English, program design languages, data dictionaries, Nassi-Shneiderman charts, control graphs, etc. are tools and methods available this level.

3.2.6 Implementation Design

Implementation refers to the actual coding of modules in terms of standards and procedures. The modules should reflect the program specifications in terms of delivering services to the proposed system. The implementation must match the design in terms of functionality, data structures, performance, architecture, modularity, interfaces, I/O, algorithms and control. The implementation must reflect the guidelines and framework defined in the module specifications. Binding, coupling and control structure principles must be applied. The implementation of algorithms and data structures must match the intended purpose of a module.

3.2.7 Database Design

Although data structures, I/O requirements, functional requirements and data flows provide a basis for designing a database, additional information must be acquired during the analysis phase to utilize methods and tools available for database design. Entity-Relationship (ER) diagrams and Bachman Diagrams are commonly used representations. Entity analysis and attribute synthesis are two methods that can be used to support the database design process. The data dictionary is a valuable tool in the database design process.

3.3. Quality Assurance and Control

Quality assurance should be utilized during each phase of the system life cycle. The system must behave reliably and predictably. Consistency, accuracy and completeness are important attributes of a system. Although testing is an important technique to determine validity, quality must be designed into a system it can not be tested into a system. Quality assurance begins at the analysis phase and extends through the maintenance phase. A number of tools and methods are available for this purpose but not all methodologies include them.

3.3.1 QA-Analysis Phase

During this phase information is collected describing a current system and its desired enhancements or a proposed system. This information is represented in forms that represent the requirements definition and requirements specifications. It is desirable to ensure validity, completeness, accuracy and consistency at this point since it has been shown that the later in the life cycle an omission or error is found the more costly it is to repair. The requirements should be traceable throughout the entire life cycle. At this stage a considerable amount of client/designer interaction is required. All collected data must be verified using historical comparisons, comparison with similar systems, sampling techniques, walkthroughs and client verification.

3.3.2 QA-System Design Phase

The QA during this phase must ensure that the functional and non-functional requirements are met. Additionally, the characteristics of good design must be ensured. Methodologies with formal specification languages that utilize automated techniques arevailable. Technical reviews and walkthroughs also provide QA. Design simulations and rapid prototyping are useful techniques for establishing surface level QA.

3.3.3 QA-Program Design Phase

During this phase, a Program Design Language (PDL) processor can perform consistency and some logic checks. It may also produce cross reference to requirements documents, DFDs, data dictionaries and other relevant requirements and design data. Other representations such as pseudocode, flowcharts, Nassi-Shneiderman charts, etc. may be used for technical reviews and walkthroughs.

3.3.4 QA-Database Design

The ability to perform logical analysis, simulations and compute performance estimates are critical to many systems. The capability to relate each requirement to the database structure provides traceability, completeness, consistency and performance checks that minimize errors and omissions occurring at a later phase. The design of database files and records to meet hierarchical, network, relational or a non-standard structures for a system to ensure quality control is as important as structuring program modules. The database structure should ensure data integrity, data independence, error control, modularity and other characteristics of good database design.

3.3.5 QA-Program Module, Package and System Implementation

Quality assurance must be maintained during the actual writing of program code. A set of guidelines and standards should be established and utilized during this phase. Program design may specify a class of algorithms or even a specific algorithm to be used. How the algorithm is converted into actual code may take many forms. This is where program testing must be employed to eliminate defective software. Errors may be of several types including:

a. algorithmic errors
b. computation and precision errors
c. capacity or boundary errors
d. timing or coordination errors
e. recovery errors
f. interface errors

The purpose of testing is to demonstrate the existence of an error. Testing is typically performed in stages:

a. module/unit testing
b. integrating testing
c. functional testing
d. performance testing
e. acceptance testing
f. installation testing

When the testing is performed in a simulated environment the results are said to be verified. When the tests are performed in the actual/user environment the results are said to be validated. Test methods involve program reviews, program walkthroughs, code inspections, formal proofs, symbolic execution and execution against test cases. Automated tools such as test data generators, code analyzers, structure checkers, data analyzers and sequence checkers are useful in the testing process.

3.4 Mechanism Clarification

As stated by (2), "all systems are combinations of hardware, software and people." The capability of a methodology to specify which of these mechanisms are responsible for the implementation and operation of individual functions has an impact on the design of a system. Functions to be performed by people or hardware are analyzed and designed quite differently than those that are to be performed by software. It is not always efficient to delegate to software a function that a person can perform. For example, a program module that assigns equipment to customers may select the specific piece of equipment that a human is to retrieve from inventory but it may be more efficient to simply let the human retrieve a piece of equipment and inform the software module of the one selected.

3.5 Interface Specifications

A system has different types of interfaces that must be explicitly identified during analysis, defined during design and utilized during implementation. Methodologies support interface identification and definition at a number of levels. At the highest level, interfaces between the system being analyzed and designed and other systems (the environment) must be identified and specified.

Other interfaces deal with I/O details in terms of screen displays, dialogues, graphics and reports. At the lowest level the interfaces among program modules must be completely specified.

3.5.1 System Level Interfaces

Every system either exists within another system or has boundaries with other systems. These other systems typically require an interface with the system under consideration. The boundaries form the interfaces among systems. Typically, the data that flow across the interface is considered of prime importance but other information may flow across the interface which may affect the analysis and design of a system. This information may be in the form of policies, procedures, legal constraints, political constraints and others. These types of interfaces must be represented in the specification of requirements, design, implementation, operation and maintenance. Some data dictionaries can record this type of information.

3.5.2 Function Interfaces

The interfaces among functions is the basis for many other interface specifications. The data flow diagram is intended to show at a general level the data interfaces but without any temporal attributes. Data typically flows out of one function and into another. In some cases there may be a temporal delay in which case the data may be stored in a file, database or memory buffer until it is needed.

3.5.3 Input/Output Interfaces

There are at least three levels of interfaces for this factor. One is the interface between the file system, record management system or database management system and the application software. The second is the interface between the hardware devices across which data must be transported. This may require code conversions, protocol conversions and electrical conversions.

The third and probably the most important is the interface between the human user and the system inputs and outputs. This level may have many characteristics but some of the most common are display formats (CRT screens, printed reports and graphical displays), dialogue design and hardware interface devices (keyboard, lightpen, mouse, joy stick, stylus, etc.). Some methodologies are relatively strong in terms of the data aspects of human interfaces and relating displays and reports to hierarchically structured functions and modules but few deal with the human factors aspects.

3.5.4 Program Module Interfaces

The connection between a calling module and a called module can be described at two levels: from the calling module viewpoint and from the called module viewpoint. Both types of descriptions are useful. The description in terms of the calling module are formal parameters which are frequently represented in a structure chart or an interface table. The interface from a called module point of view is in terms of actual parameters and how they and other data are accessed and used. A called module may have access to data that is not among the formal parameters passed by a calling program. It is important to represent these data interfaces.

3.6 Documentation

Documentation refers to written descriptions that accompany diagrams, charts,tables, specification languages, data descriptions, raw data and other representations of the analysis, design, implementation and maintenance. This is invaluable for maintenance and redesign as well as for other system projects. A methodology should specify the form, format and procedures for documentation.

3.6.1 Analysis Documentation

This includes an environment description, problem description, methodology descriptions, function descriptions, data analysis descriptions and feasibility interpretations. This is utilized to provide information as to why requirements (functional and nonfunctional) are included in the definitions and specifications.

3.6.2 Design Documentation

This includes a description of the design process, why various design decisions were made, why certain structural decisions were made and the relationships between requirements and design.

3.6.3 Implementation Documentation

This includes program documentation at both the internal and external levels. Internal documentation is descriptive text written directly within a program module while all other written descriptions about the module is considered external documentation. Internal documentation for a module may include what the purpose is, who wrote it, where it fits in the system structure, when it was written, the parameters in the called argument list, how it uses data structures, algorithms and controls, how errors are handled, modules called, basic logic flow, how to test it, each change made by whom and when and expected extensions or revision and how to make them.

3.6.4 Operational Documentation

Documents such as users manuals, operators guides, reference manuals and training materials are valuable assets to the success of a system. The content as well as the form and format of these types of operational documentation must be specified and meet the same quality assurance as program modules.

3.6.5 Maintenance Documentation

System development is considered complete when the system is operational in its native environment. A change to the system after that point in time is considered maintenance. In reality, maintenance may begin during the development phase as omissions or revisions in specifications occur. Maintenance may be corrective, adaptive, perfective or preventative. An important aspect of maintenance is the management of change. Configuration management is the control of changes to a system so that the state of every component is documented and available to all who must analyze, design, implement, test, use, maintain or evaluate the system. Changes are typically represented on a change request form. The primary issues related to the management of change and its documentation are: synchronization, identification, naming, authentication, authorization, routing, cancellation, delegation and valuation. A methodology should include maintenance procedures and the documentation of changes.

3.7 Automated Support

As systems have gotten more complex, the amount of data that must be collected, analyzed, maintained, related, verified and communicated has increased in volume and complexity. Also the numbers and types of people involved has also grown in number and complexity. This has resulted in increased costs for developing and maintaining systems. The application of automation to all the phases of the life cycle offers some potential increases in productivity and decreases in costs and errors during system development. Automated specification systems such as PSA/PSL and SREM have shown potential in the requirements areas. A variety of automated tools and methods have proved useful for the design phase. These include data flow diagrammers, program design languages, data dictionaries, data flow checkers and others. Prototyping is a tool that is useful in the analysis and design phase. Implementation and testing is supported by language sensitive editors, flow analyzers, symbolic debuggers, test data generators, application generators, program generators and database management systems. Human interface design has been aided by forms management systems, forms generators and dialog generators. Maintenance is supported in terms of configuration management by code management systems such as the Unix "make" facility.

The movement is towards an automated system development environment which would integrate all the tools and techniques within a single domain. Some of the AI development systems such as knowledgecraft attempt to provide such an environment.

3.8 Management and Project Support

Good management is crucial to the success of a system development project. Successful management of a project involves four basic factors: organizing, scheduling, resource estimation and control(8).

3.8.1 Organizing

This involves identifying the tasks to be done, separating them into manageable subtasks and determining who will be responsible for each task with sharply defined objectives.

3.8.2 Scheduling

This is the determination of when each task must be performed relative to all the other tasks. Some tasks may be performed independently and in parallel while others are dependent on the prior completion of related tasks. This is typically done in conjunction with resource estimation.

3.8.3 Resource Estimation

An estimate of how long each task will take and their cost is essential to any project. It is one of the critical factors in determining whether to proceed with a project. Lack of adequate time is a common reason for project failure and people cannot be substituted for time.

3.8.4 Control

Control is an activity that continues throughout the life of the project. Both the progress and quality of the project must be determined. This provides an early warning system that a project is in trouble and that management must make revised plans, estimates, costs, personnel and/or procedures.

3.9 Summary of Methodology Dimensions

The preceding dimensions desired of a system design methodology with their subcategories only presents a macro view of the system development characteristics that may act as factors for comparing, selecting, evaluating or designing a methodology. A micro view of each dimension and its subcategories would provide a more detailed set of criteria for characterizing methodologies. At the current state-of-the-art, this would not significantly improve ones ability to make critical judgements since none of the current methodologies provide a complete, integrated set of methods and tools that cover all phases of a system life cycle.

The current trend towards prototyping and the previous emphasis on structured methods can be combined with the historically based flow methods to provide a range of methods and tools that cover most of the system life cycle.

It appears from the analyses that myself and others have done on systems analysis and design methodologies, that no single methodology, method, tool, procedure or technique supports the complete system life cycle for todays complex systems. An analyst must select the best set of methods, methodologies and techniques that represent the multiple viewpoints and dimensions of a system as it passes through its life cycle. The unfortunate problem that incompatible representations present is that it is difficult, if not impossible, to provide intra-life-cycle phase traceability, verification, consistency and quality assurance.

Although there are adequate representations for most phases of the system life cycle and the dimensions that characterize each phase, they are not contained in a single methodology. Most methodologies provide good representations for certain aspects of the life cycle phases and weak or no representation for other dimensions. Future methodologies will most likely integrate a variety of methods, tools and techniques that cover the full range of life cycle phases into a systems development environment with compatible representations.

4.0 A Comparison of Selected Methodologies

Utilizing the dimensions of system design methodologies as presented above, the tabular representation rating the following methodologies is presented, the scaled used in rating a methodology was L-Low, M-Medium, H-High and N-None. These ratings are the subjective judgement of the author in conjunctions with several articles that have been published or distributed by others in attempting to accomplish a similar goal. The methodologies selected for rating were those that are currently being utilized and generally have proven to be an improvement over the seat-of-the-pants approaches utilized in the past. The methodologies selected for rating on the specified criteria are:

HIPO - Hierarchy Plus Input Process Output
SADS - System Analysis and System Design
JDM - Jackson Design Method
SADT - Structured Analysis and Design Technique
Warnier/Orr - Ken Orr Methodology

The judgements made for the ratings do not reflect improvements and additions made to these methodologies over the last year or two (9, 10, 11, 12). The definitions for each rating is:

N - The methodology does not address the dimension.
L - The methodology does not directly provide a tool, method, data, rule or guideline but indirectly provides one or more of these for the dimension.
M - The methodology directly provides some tools, methods, data, rules or guidelines but is incomplete for the dimensions.
H - The methodology directly provides tools, methods, data, rules and guidelines in nearly a complete manner for the dimension.

Dimensions	Methodologies				
	HIPO	SASD	JDM	SADT	Orr
*Structural					
General Structure	H	H	H	H	H
Data Flow Structure	M	H	L	H	N
Data Structure	L	L	H	M	H
Control Structure	L	M	H	L	M
*Level of Analysis and Design					
Requirements Definition	N	L	L	L	L
Requirements Specification	L	M	M	M	L
Conceptual Design	M	H	H	H	H
Technical Design	M	H	H	H	H
Program Module Design	M	H	H	H	H
Implementation Design	L	M	M	M	M
Database Design	N	L	L	L	L
*Quality Assurance and Control					
Systems Analysis	N	L	L	M	L
Systems Design	L	L	L	L	L
Program Design	L	M	M	M	M
Database Design	N	N	N	N	N
Program Implementation	N	L	L	N	L
*Mechanism Clarification	L	L	L	H	N
*Interface Specifications					
System Level	L	M	M	H	M
Functional Level	L	M	M	H	H
Input/Output					
Hardware	M	L	L	L	N
Software	M	M	H	M	L
Human	L	L	L	L	N
Program Module	M	H	H	M	M

*Documentation					
Analysis	N	L	L	H	L
Design	M	M	M	M	H
Implementation	N	M	M	L	M
Operation	N	N	N	L	L
Maintenance	N	N	N	L	N
*Automated Support					
Requirements	N	N	N	H	N
Design	N	L	L	M	L
Implementation	N	L	L	N	L
Maintenance	N	N	N	N	N
*Management and Project Support					
Organization	L	L	L	L	L
Scheduling	N	N	N	N	N
Resource Estimation	L	L	L	L	L
Control	L	L	L	L	L

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BUILDING USEFUL AND VIABLE SUBNATIONAL ECONOMIC INFORMATION SYSTEMS

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(Extracts)

(*)This paper was originally scheduled as a working group background paper. However, Mr. Steger kindly accepted to present it as a substitute for Mr. Williams' paper which was not presented as he was unable to attend.

1. INTRODUCTION

The purpose of this paper is to bring to the attention of the International Conference on Strategies and Methodologies for the Design and Implementation of Information Systems in Public Administration (with special emphasis on Economic Information Systems) a critical but frequently ignored - and certainly underemphasized - subject in high-level strategy discussions of presently used public administration approaches to the design and implementation of economic information systems. While most such discussions focus on the national and international levels, e.g. the National Income and Products Accounts (NIPA), Input-Output Tables (I-O), and econometric models for nations and their interactions, many if not most of the technological improvements of the past three decades in software, hardware, and information system, design have benefitted the public decision-makers at subnational levels.

Here, we refer to information for and about multi-province (or multi-state) regions, states and provinces, cities, neighbourhoods and even more micro-level geographic units. Superior information systems at these levels can and do provide an upwards, "bottoms-up" thrust which, properly conceived, meshes well with the typically top-down designs of national level systems. Differences, of course, exist between each of these levels : the interests of these subnational levels are, by definition, more localized, micro and, perhaps, more "social" or "physical" than purely "economic". Frequently, key variables are referred to as "socioeconcmic"; in any case, such data are vital to improved decision-making at these lower geographical levels, though they do draw heavily upon the "top-down", national level information systems (e.g., national censuses, national income accounts, etc.) for the preponderance of their ultimately localised basic information resources.

2. CASE STUDIES : GEOGRAPHICAL INFORMATION SYSTEMS

Designing a subnational information system requires a close working relationship between the information specialist and decision makers. The relationship is typically conditioned by three main variables dependent upon : a) the organizational structure, b) the methods and processes used to plan, budget and deliver the information services, and c) the type of technology in terms of hardware/software that is employed in the environment.

One of the key problems in the development of a subnational geographic information system (GIS - also referred to as IGS/GIS" for "interactive computer graphics/geographic information system") is, frequently, the lack of a clear understanding of the decision processes, functions, and associated information requirements of the potential system users. The development of this understanding requires a knowledge of the interrelationships among: the management and administrative structure of the organisation, the functions of the various managers, the information required to support these functions, and the system to supply this information. To determine these interrelationships, an experienced team's approach to the analysis of management decision-making typically consists of the following five steps :

- identify and classify major management decision or function categories requiring the use of planning and development information;
- conduct interviews with planning and development managers to determine management decisions/functions performed, method of performance, and type and quantity of information used in the decision process : develop a matrix of management decisions and functions for each manager;
- develop current decision-making models for each decision or management function category;
- develop preferred decision "models" for each category: identify broad information requirements to support the decision categories; develop a matrix of information requirements by decision category for each manager, and determine the degree to which these requirements are satisfied by current information systems; develop an information requirements/availability matrix and determine impacts of information availability on decision-making.

Such models range from basic to more exotic - with no particular benefit accruing for increased sophistication, **per se**; however, in most cases, increased modeling complexity frequently facilitates and accompanies additional decisional complexity.

2.1. The "Basic" System (*): Facilitating Day-to-Day Urban Operational Management

A good source for acquiring timely data inexpensively is, frequently, through a range of city departments, public agencies, and governmental units. For example : tax assessors inventory property; building inspectors evaluate housing quality and new construction; health agencies record births, deaths and incidence of disease; and water meter readers record water consumption. The information gathered by city departments and other public agencies often is stored in computer files in the data processing department. The amount of data collected can be so staggering that a computer is the only reasonable method for processing it. For example, if a tax assessor assesses 160,000 properties and collects 300 characters of data on each property (e.g. address, value, and year built), more than 40 million characters of data will have to be stored. On magnetic tape storage along, this data base would be half a mile long.

To be able to use all the information generated by governmental activities requires the use of technological developments in data processing which standardise, integrate, analyse, and display data. The capability to retrieve data by any attribute, to provide statistical summarization of the data, and to display information on maps makes sense out of tremendous amounts of data collected by various city departments.

Exhibit 1 shows the relationship among data categories for a typical mapping and lands records system (City of Milwaukee).

(*) Adapted from Huxhold, William E., "Modernizing Land Information Systems for City Planning and Management: Problems and Opportunities", Milwaukee, 1987.

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Exhibit 1

CROSS REFERENCE OF ORGANIZATIONAL USAGE OF COMPUTER GRAPHICS

PAGE 1

╱ USED ▨ USED FREQUENTLY ■ USED CONTINUALLY

SOURCE	SOURCE(SEE BELOW)	1				2				3					4			5						6		7			8			9		10		11		12			13				14		
	APPLICATION #	1	2	3	4	1	2	3	4	1	2	3	4	5	1	2	3	1	2	3	4	5	6	1	2	1	2	3	1	2	3	1	2	1	2	1	2	1	2	3	1	2	3	4	1	2	3
	APPLICATION DESCRIPTION / USER ORGANIZATION	STR SECTION MAPS	CONSTRUCTION/PAVING	CURB LINES	HOUSE NUMBER ATLAS	LANDUSE MAPS	CHOROPLETH MAPS	THEMATIC MAPPING	ZONING	PLAN EXAMINATION	INSP. WORKLOAD MGMT	VIOLATION MAPPING	REDISTRICTING	THEMATIC MAPPING	TAX PLAT MAPPING	CHOROPLETH MAPS	THEMATIC MAPS	STREET LIGHT SYSTEM	UNDERGROUND CONDUIT	TRAFFIC SIGNAL RECORDS	TRAFFIC CONTROL MAPS	ACCIDENT DATA	THEMATIC MAPS	ELECTION DIST. MAPS	REAPPORTIONMENT	CABLE TV MONITORING	VIOLATION INSP.	THEMATIC MAPS	INSP. MGMT	VIOLATION MAPPING	THEMATIC MAPS	CHOROPLETH MAPS	BUSINESS GRAPHICS	CHOROPLETH MAPS	BUSINESS GRAPHICS	CHOROPLETH MAPS	BUSINESS GRAPHICS	ARSON INVESTIGATION	THEMATIC MAPS	RESOURCE ALLOCATION	CRIME STAT. MAPPING	THEMATIC MAPS	RESOURCE ALLOCATION	AUTOMATED DISPATCH	GARBAGE COLLECT. STAT.	SNOW REMOVAL MGMT.	OFF-STREET PARKING
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One example of data interrelationships can be found in the Building Inspection Department. The City Building Inspector may wish to determine what it would take to inspect every home in a target area of the city once every three years. This can be accomplished by relating the amount of time spent by inspectors, on housing inspections (as opposed to administrative, clerical, and other non-inspectional activities) to the number of inspections made. By obtaining the number of homes in the area to be inspected, it is possible to determine the number of inspectors required. This process can be achieved through the use of various city data files under control of a data base management system.

Similar examples of integrating data among different data sources for use in management and planning are:

- material costs per mile of street

- tax revenues per vacant lot

- housing inspections of tax delinquent properties, and

- project costs by areal unit (e.g. census tract).

By developing a comprehensive ICG/GIS system and implementing systematic procedures to keep the data accurate and current, responses to information needs such as these cannot only be met, but can also be met in a timely and cost-effective manner, with improved overall decision effectiveness.

In most cities it is extremely difficult to obtain, analyse, and display information describing existing conditions in housing, land-use, commercial activity, or vacant land. Data which is used is often inaccurate, out-of-date, or very expensive and time-consuming to obtain. This is because most city databases are disjointed and maintained in a decentralised fashion. Frequently, data collection by one department is not available to other departments because the geographic codes used by one department are unique; or because the data coding structures are different. The situation is that data collected and maintained by one department is assembled for one specific purpose (assessing property, inspecting buildings, reading meters, etc.) when, in fact, they can be useful to other departments (or other uses within the department) for planning, operations and management, if they were in a flexible form.

Many, if not most, urbanised areas of the U.S. have designed and/or adopted a system of citywide data bases, best meeting their needs, containing information collected by city departments and other public agencies which can be used to improve their management, planning, and policy decisions. Only by developing a computerised system of geographic and property descriptive information in a centralised manner can the vast amount of data available be reduced to manageable size and utilised to improve urban decision-making.

Ever since the early 1960s, when the U.S. government funded the ambitious Integrated Municipal Information System (IMIS) Program, there has been a trend within cities to organise and combine their various data systems relating to land information. In many instances, these efforts have had two major components: combining data describing land and property (non-graphic) and combining geographic data from maps (graphic). Both efforts can be extensive, requiring large amounts of money and involving the political aspects of gaining the cooperation of many different departments and agencies.

Perhaps it goes without saying: a structured approach needs to be utilized to elicit the optimal "statement" or urban data needs which a GIS can provide. In an examination of the current planning decision processes in a major U.S. city, one can readily identify a list of several dozen management functions or decision processes. These categories may be considered to be generic in the sense that nearly all apply to each of the urban managers interviewed during the course of the requirements analysis (with, of course, varying applications and degrees of emphasis). Functions tend to be grouped under headings such as: Planning, Implementation and Control, and Monitoring and Evaluation, or, for other purposes, On-going Procedural and On-going Managerial. In previous and ongoing projects, department heads and other key personnel are interviewed to determine the applicability of specific decision categories to his/her responsibilities, the relative importance of these processes, and methods and information used in performing these functions.

The interview summaries are analysed and decision-making "models" are developed for each decision process. The models describe the methods used currently in performing the various functions, types of information used, and the resulting effects on decision-making. Similarities and differences in approach among the various managers are described in these models.

In this way, the information system can be designed to support both the current and the prospective management, administrative, planning and development decision-making activities. Information requirements of administrators, planners, and/or decision-makers will, in this way, be defined so as to include:

- Data to support complex decision processes with regard to analysis of client problems, organisation of service delivery systems, and environmental phenomenon ;

- Data to provide a better understanding of the clients, programs and services, and environment, by providing decision-makers with more comprehensive, more current, more relevant and more accurate reports and

- Data to support operational activities which facilitate the performance of services.

For planning and development activities, in particular, it is most important that the information system support the less predictable and non-routine information needs. These are particularly well-suited to the speed, flexibility, and analytical capabilities offered by ICG/GIS systems.

2.2. Land-use Activity Allocation Models

The most comprehensive urbanised region and economic and social development and planning model systems generally are comprised of these components:

- Economic-Demographic Models which use economic base concepts, statistical estimating equations, cohort-survival population dynamics, and informed opinion to project regional population and activity totals in response to economic and social factors impinging upon the region and its future;

- Land Use Activity Allocation Models (AAM) which use economic-demographic outputs and statistically derived estimating relationships to distribute households and employment to subareas of the region in response to development factors, policy variables, and activity indicators, in addition to determining evident departures from desired development results and calculating likely future land usage amounts;

- Transportation Planning Models which draw on AAM outputs to determine trip generation, trip distribution, modal split, and trip assignment patterns for a regional transportation system serving a finer-grained array of transportation planning zones; and

- Data Bases which underly planning models - as well as serving other needs - by providing input data for the models and other planning purposes, serving as a sequential data source for successive models in the planning model series, and absorbing planning model outputs as data for use in other regional planning activities.

In this section, our focus will be on land use activity AAM's, the most sophisticated - and ambitious - urban area decision support systems presently found in approximately one-quarter of the major U.S. metropolitan areas.

2.2.1. Evaluation of Land Use AAM's

Most urban transportation and land use modeling/planning systems contain the elements depicted in Exhibit 3 and are descendants from the late 1950's Detroit and Chicago Metropolitan Area Traffic Studies (*). The traditional process was initiated with the forecasting of measures of growth in socioeconomic activity (e.g. population, employment, personal income) for the entire metropolitan area, based on a prorating of national or regional trends or some other such projection strategy. These overall totals were then allocated to small subareas wtihin the total region, by some strategy which was initially void of any explicit sensitivity to transportation. This strategy was called a "land use model", since it determined land consumption associated with the socioeconomic activity forecasted for each subarea. Based on these land use forecasts, volumes of traffic origination and of traffic termination were then estimated by a "trip generation" model. Concurrently, existing utilisation patterns were reviewed to identify major congestion problems, in reference to which planners would then specify alternative "skeleton" transporation systems options for the future. Such "skeletons" were fashioned to cover a range of alternatives from a systemwide perspective; but they left considerable freedom for more detailed location and design decisions for isolated components of such skeletons. Given these skeleton specifications and the small area trip generation forecasts, demand forecasts were then made to estimate the equilibrium pattern of network utilisation for each hypothesized skeleton. These demand forecasts were derived by a series of models which characterized direct effects as a function of hypothesized transportation policy variables and socioeconomic variables.

Criticized extensively into the mid-60's as being overly narrow (**) changes evolved from these initiatives:

Change 1: Initial speculation by land use planners on qualitative notions of future land use patterns, and the use of these alternative land use "hypotheses" to generate alternative netowrk flows.

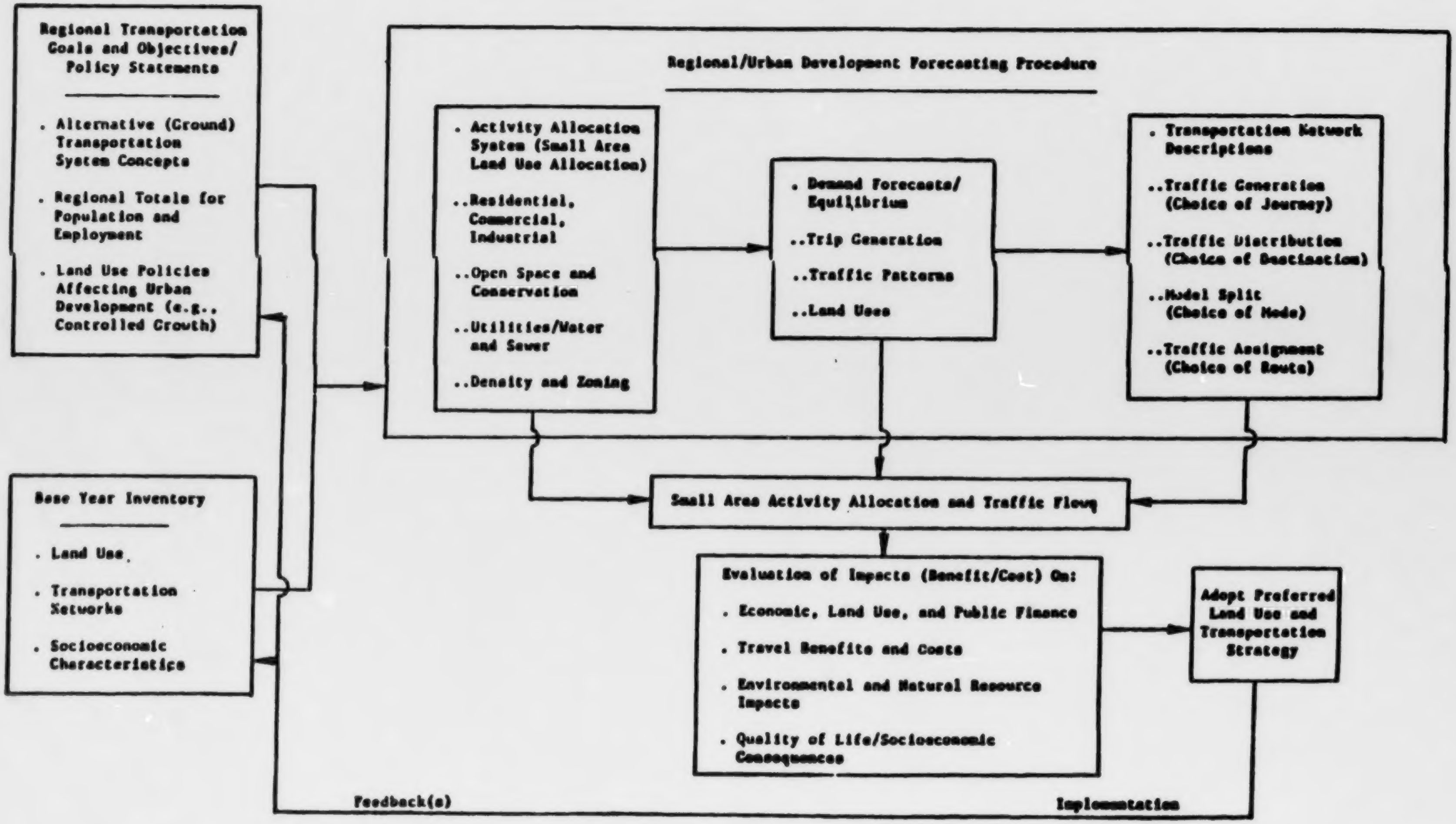
Change 2: Later, planners/modelers incorporated transport sensitivity into their subareal land use forecasts, which in turn gave more meaning to the demand forecasts. The land use allocation models were rendered sensitive to transportation by means of an "accessibility" variable, a moment-type measure which weighted the socioeconomic attractiveness of other subareas by the difficulty of travelling to that subarea (i.e., intermodal impedance). These impact models characterised indirect effects as a function of transportation policy variables.

(*) Adapted from the Governor's Committee for Transportation, Final Report: Methodological Framework for Comprehensive Transportation Planning, Pennsylvania Transportation and Traffic Safety Center, Pennsylvania State University, 1967.

(**) Steger and Lakshmanan, "Plan Evaluation Methodologies: Some Aspects of Decision Requirements and Analytical Response", paper presented to Highway Research Board Conference on Urban Development Models, Dartmouth College, Hanover, New Hampshire, June 1967.

Exhibit 3

Comprehensive Urban Transportation/Land Use
Allocation Analysis and Planning Process: A Simplified Representation


Regional Transportation Goals and Objectives/ Policy Statements
. Alternative (Ground) Transportation System Concepts
. Regional Totals for Population and Employment
. Land Use Policies Affecting Urban Development (e.g., Controlled Growth)
Base Year Inventory
. Land Use.
. Transportation Networks
. Socioeconomic Characteristics
Regional/Urban Development Forecasting Procedure
. Activity Allocation System (Small Area Land Use Allocation)
..Residential, Commercial, Industrial
..Open Space and Conservation
..Utilities/Water and Sewer
..Density and Zoning
. Demand Forecasts/ Equilibrium
..Trip Generation
..Traffic Patterns
..Land Uses
. Transportation Network Descriptions
..Traffic Generation (Choice of Journey)
..Traffic Distribution (Choice of Destination)
..Model Split (Choice of Mode)
..Traffic Assignment (Choice of Route)
Small Area Activity Allocation and Traffic Flows
Evaluation of Impacts (Benefit/Cost) On:
. Economic, Land Use, and Public Finance
. Travel Benefits and Costs
. Environmental and Natural Resource Impacts
. Quality of Life/Socioeconomic Consequences
Adopt Preferred Land Use and Transportation Strategy
Feedback(s)
Implementation

Change 3: In this most current approach, the results of the land use allocation model were fed directly to the "evaluation" stage, since such estimates of impacts (indirect effects) were increasingly valuable information for decision-makers; that is, the consideration of larger and larger scales of transportation investment as well as alternative land use policies led to a conscious use of indirect effects, aroused to an appreciable extent by particular interest groups and their perception of realized impacts..

In carrying out a planning process where planning models are used, those involved - planners, systems analysts, economists, and public administration specialists - have increasingly stressed the need to move from the process and mechanics of model building to development of a product that suits users' needs and provides them with information they want. Stressing, essentially, that realistic model system strength comes from user interest more than from technical sophistication or analytical elegance places model building and use within a much larger context of policy analysis and plan implementation(*)

Very often "user-oriented" means, in operational terms, technical users and builders of models. And that is true. But, more and more, users are planning managers, public officials, decision-makers, public participants, and all the other "actors" on the metropolitan scene. Many of these persons are currently only prospective users. Nevertheless, a major thrust of urban and regional planning today is seen as surveying these prospective users to determine how their concerns and land use and transportation models can be combined in a practical planning context.

Having built models in many metropolitan areas, planners (and other urban decision-makers) have then plunged onward into using them for planning purposes. There are a large number of applications of specific models to land use planning, transportation planning, fiscal impact estimation, air quality projections, river basin studies, and a host of other assignments.

A full recounting of all users of these systems - past, present and future - would fill this paper and, indeed, many books; however, a few general thoughts about applications are in order. The assertion that the computerised land use and transportation planning models can be - and have been - used to serve a wide variety of planning purposes is based on a good deal of supportable evidence that a property structured and appropriately responsive battery of models can serve a wide array of metropolitan (urban and regional) planning purposes. More and more, given the available techniques, a battery of planning models can be so designed that they produce either generalised regional development patterns or detailed local area allocations for zones suited to whatever specific planning assignment is at hand. A compact system can readily and inexpensively generate overall patterns likely to be relevant to almost any regional concern one might come across. In similar fashion, subregional systems designed to fit the development dynamics and geography of specific subareas can generate individualized patterns of activity uniquely responsive to particular forces impacting those places. And, finally, even more detailed small zone allocations - tailored to the particular zone-by-zone characteristics most relevant to transportation planning, housing concerns, environmental considerations, or even fiscal implications - can be generated as a follow-on output.(*)

(*) See Donald F. Blumberg, "The State-of-the-Art in Implementing 'Successful' Management Oriented Urban and Regional Information Systems", URISA Conference Proceedings, Toronto, Canada, 1980.

(*) Such results can be produced by means of inexpensively operated Zonal Allocatio Procedures (ZAP) designed to, essentially, rearrange basic planning projections to service particular planning requirements.

Underlying this generalisation is an equal realisation that models cannot do everything one might want them to do. Nor can they generate reliable and sensible results at the extremely fine-grained detail often called for to serve particular planning requirements. Models are obviously ineffective at anticipating types of behaviour which have seldom happened. They are equally suspect when pushed to directly generate extremely minute detail from gross - and highly conditional - regional control totals. And they are quite suspect when applied to areas of concern in which substantial and very generalized uncertainty exists.

Indeed, it is possible to design, although few planning efforts have yet done so, a two-tiered Activity Allocation System in which successive levels of areal detail are determined from preceding higher-levels (i.e., larger areas) with feedback between the levels to ensure feasibility and consistency.(*) Recognizing the limitations of virtually any collection of models, a multi-level structure can be managed to serve a wide array of functional planning concerns because it can be set up so that a specific application is tailored to both the substance and the detailed geography of the problem at hand. These are potential applications :

- Generalised regional development patterns for sketch planning of alternatives followed by more detailed allocations of particularly promising alternatives;

- Particularised transportation planning designed to test system alternatives at the detailed transporation zone level for purposes of program certification and evaluation of planning opportunities

- Functionally oriented detailed planning in which general regional and countywide activity allocations are then distributed to small-scale functional areas for examination as generalized patterns expressed at reasonably approximated functional detail;

- Selective impact evaluation of major public and private development proposals to serve regional planning review needs (**) and to generate indications of emerging regional issues as actual development takes place;

- Imaginative assessment of regional strategy alternatives under consideration for metropolitan area adoption in order to maintain regional initiative in development planning and growth management; and

- Annualized regional and countywide updates of regional economic and population projections accompanied by AAM two-level allocation of employment and households in order to monitor - or anticipate - changing patterns and trends on a year-by-year adjustment basis.

What the above examples suggest is that functional planning requirements are undertaken because there is concern about present or prospective problems of specific kinds. Whether models are available or not hardly changes the need for such planning. It simply means that - where models are available and applicably structured - they can be used to test more alternative in terms of a larger span of consistent measures than would otherwise be the case.

(*) CONSAD Research Corporation, Review of PSCOG Computerised Planning Models and Data Bases, prepared for the Puget Sound Council of Governments, 1978.

(**) Procedures for metropolitan area planning, providing centralized planning powers and responsibilities to regional planning agencies relative to localised, subarea planning decisions, have been designed for U.S. subareas.

Furthermore, there are a host of new concerns facing urban areas, during the 1980s, requiring even more complex decision making than has been required in the 1960s and 1970s. And there are those who are attempting to mesh new decision-making and planning needs with the capabilities of existing model systems. Policy analysts may turn to these systems to better assess ways of dealing with negative urban growth, the assessment of new housing programs, the evaluation of market-oriented land use incentive systems, and/or new apporaches to tax base and revenue sharing, property tax reform, and a host of other "new" urban challenges. Certainly, land use models in their portrayal of the economic relationships which characterise land use decisions seem to be gaining selective acceptance due to their potential for providing rapid insight into topical issues. However, in using these, or other similar quantitiatve models, policy makers must continually examine and question the validity of the model's structural (and thereby its output) validity.

2.2.2. Activity Allocation Techniques - Limitations and Opportunities

This is not the place to provide an in-depth review of techniques used in computer-assisted urban development and planning modelling: the literature is extensive. There are several ways to classify and categorise land use/activity allocation models. How they are designed and "built" is an important way, not only because it helps to understand what is needed to make each model "work" but also because it may make it simpler to understand how to use them.

The models fall, more or less, into certain categories insofar as their projection methodology is concerned:

(1) controlled variation of independent variables

(2) simulation forecasting models, and

(3) analytical mathematical models.

These are not mutually exclusive choices within a total effort, for some of the studies use all of these in combination. They will be classified below, however, under their primary usages. Morover, the statistical techniques used for parameter estimation in each of the model systems (e.g. factor analysis, multiple regression, and so on) are not necessarily related to the projective technique and so can be discussed independently of these.

Out of this variety, a number of operational models have emerged. Most are variants of the "controlled variation of independent variables" or the Lowry model: few, if any continuously operating "operational" versions of "mathematical optimising models" exist, although there are several "one-shot" applications (*). In Exhibit 5 (**) a number of features of existing operational models - including computer hardware and software capability - are enumerated, together with a consensual representative view of some of the advantages and disadvantages of these model systems. Clearly, no system is superior for all purposes - and there are several from which to choose.

A pictorial representation may be useful here. Exhibits 6 through 10 describe the interactions between residential, employment, and commercial location common to most of the Lowry-based model building efforts today.

(*) C.D. Laidlaw, op. cit.

(**) Adapted from U.S. Department of Transportation, A Review of Operational Urban Transportation Models, op.cit.

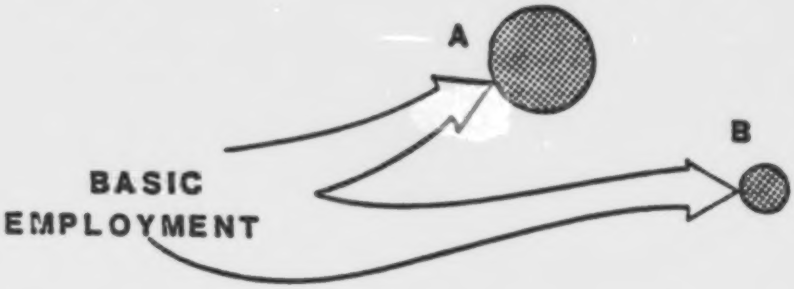
Exhibit 5

COMPARISON OF LAND USE MODELS REVIEWED

MODEL	TYPE	METHODOLOGY	RESOURCE REQUIREMENTS	AVAILABILITY	MERITS	LIMITATIONS	IS EASILY USED IN B/C IMPACT EVALUATION
PLUM	Lowry-Type	Cross-sectional; structural fully computerized	CDC 6400 or IBM 360/40 with 256K bytes for 300-zone study area; approx. 10-15 hrs. machine time required in total; 1 to 1½ man years professional time plus technical support.	Public domain (FHWA). Staff and program maintenance support available from University of California.	Simple Structure; fully operational with demonstrated viability; strong transportation orientation.	Limited Outputs; cross-sectional calibration; data requirements high; exogenous projection of "basic" employment.	Yes
USM	Lowry-Type	Structural; lagged, cross-sectional; fully computerized	IBM 360 with 250K bytes. Machine time and manpower needs uncertain but probably similar to PLUM.	Proprietary to Alan M. Voorhees & Assoc. Staff and program maintenance support available.	Simple structure and efficient calibration; basic model operational; outputs linked to other transpotation planning programs.	Some limitations on outputs; exogenous projection of "primary" employment; basic corss-sectional calibration; data requirements high; proprietary package.	Somewhat
EMPIRIC	Controlled Variation of Independent Variables	Time-dependent; econometric/structural; fully computerized	IBM OS 360/40 with 100K bytes or equivalent for 200-zone study area. Approx. 15-26 hrs. machine time required in total; 1 to 1½ man-years professional time plus technical support.	Public domain (FHWA). Staff and program maintenance support available from PMM & Co.	Flexible time-dependent structure; fully operational with demonstrated viability; policy orientation; extensive outputs directly linked to other transportation planning programs.	No unique structural base; data requirements high (two points in time); efficient calibration dependent on skill of analyst.	No
Opportunity-Accessibility Model	"Opportunity Model"	Cross-sectional; statistical; fully computerized.	IBM 7094 and Burroughs B-5500; machine time and manpower requirements uncertain, but certainly less than the other models on this list.	Public domain (NY State DOT); no direct program maintenance or staff support available (in 1978).	Very simple structure; data requirements relatively low; transportation orientation.	Very limited outputs; no continuing staff support; lack of non-transportation policy sensitivity; cross-sectional calibration.	No
UPM	Lowry-Type	Time-dependent; statistical/utility theory; fully computerized	IBM 360 computer storage; machine time and manpower requirements not specified but probably in excess of others on this list.	Initial version public (DOT/OST); final version proprietary to RSA, Ltd.; staff and program maintenance support available.	Attractive conceptual structure; time-dependent calibration; transportation orientation; unique output measures; basic model operational.	Very complex structure; conventional forecast outputs limited; residential orientation; confusion calibration process; data requirements high; cross-sectional calibration.	Somewhat

Exhibit 6

EMPLOYMENT DISTRIBUTION



Existing employment centers

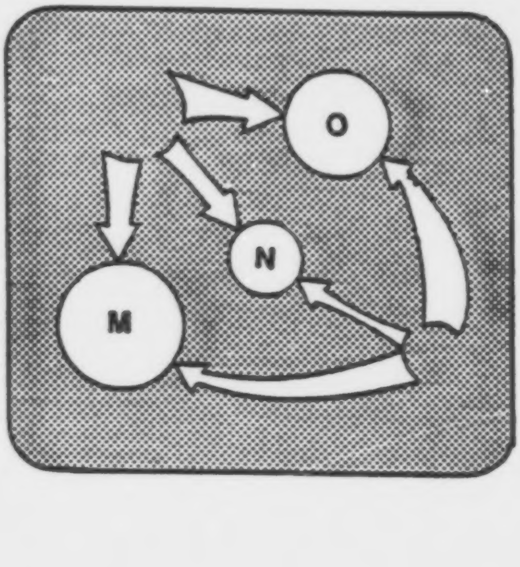
Access by rail, water, highway

Assessment

Zoning

Exhibit 7

HOUSEHOLD DISTRIBUTION



HOUSEHOLDS

Distance

Characteristics
of Households

Characteristics
of Housing

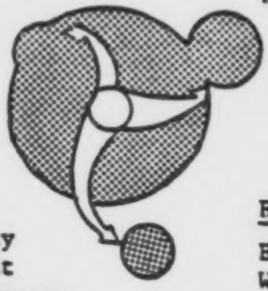
Physical Blight

Community Facilities

Social Problem

Exhibit 8

HOUSEHOLD DISTRIBUTION



HOUSEHOLD

Low Income
Primarily Non-White
Unskilled Labor Force
Shortest Distance
to Work

HOUSING

Multi-Family
Low Value Rent
High Renter Occupancy
Dilapidation Apparent
High Turnover

HOUSEHOLD

Middle Income
Primarily White
Skilled Working Classes
Medium Distance

HOUSING

2-4 Family Dwellings
Medium Value-Rent
50-Percent Owner-Occupancy
Evidence of Deterioration
Medium Turnover

HOUSING

High Income
White
Professional
Longest Distance

HOUSING

Single Family
High-Value-Rent
High Percent Owner-Occupancy
High Percent Sound
Low Vacancy

Exhibit 9

COMMERCIAL EMPLOYMENT DISTRIBUTION

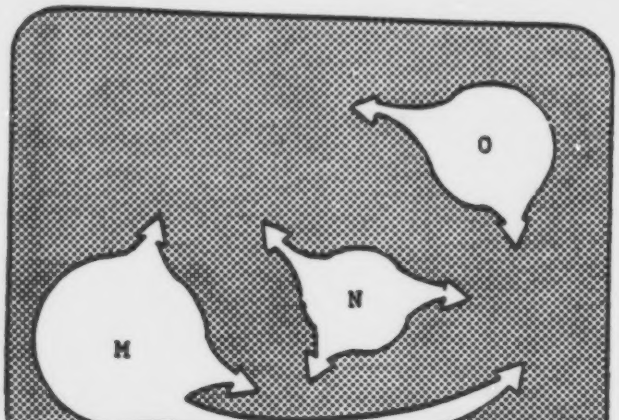
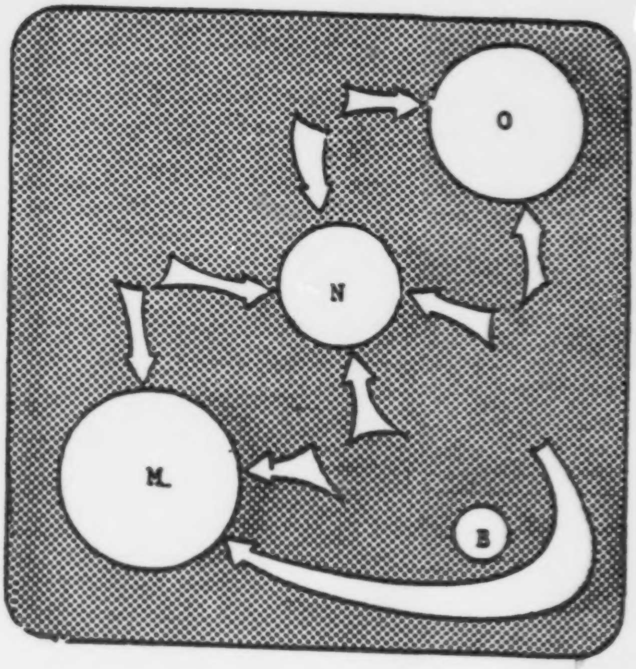


Exhibit 10

COMMERCIAL HOUSEHOLD DISTRIBUTION



3. DESIGNING SUBNATIONAL GEOGRAPHIC INFORMATION SYSTEMS

The objective of this activity - for whichever urbanized region chooses to do so - is to develop a design for a Geographic Information System (GIS) which may or may not involve economic/demographic forecasting and/or land use models. It should include an identification of the general hardware, software and related services as well as associated costs. Moreoever, it should, also, lead to the organisational and administrative arrangements for the system. The goal is to have a system design as detailed as needed and as simple as feasible.

The system to be developed will most likely include:

- land data collected and maintained by various (city) departments

- data base management which links data from (city) files together by property

- a digitized, parcel-oriented computer mapping system and

- geoprocessing and special purpose data retrieval programs.

Exhibit 11 (*) illustrates the pattern of relationships among policies, impacts and environments - for whatever specific GIS will evolve. This framework depicts the major influences - external and internal, human and technological - which can and should shape the dozens of key choices which must be made. The following "generic" aspects of each and every ICG/GIS systems are important in developing the general systems configuration characteristics and will be evaluated as part of this task.

- User Orientation. Extensive orientation is essential to fully inform the system users of the availability of data, capability of the system, and procedures for making information requests, as well as the methods to be used in acquiring and processing data and generating both routine and non-routine outputs.

- Flexibility. A successful system should be readily adaptable. It should consider the following issues:

. Copying with inevitable changes in structure and operations, with resulting modifications in data requirements of system users, through adding or removing data while providing for continual updating;

. As hardware and software improvements are made available, the systems can be expanded. Capability to handle decentralized implementation can be provided where appropriate such that features provided for in an initial "core" system could be used as the nucleus.

- Capacity. The capacity of the system should be such that all needs for information meeting specified criteria can be accommodated, with additional capacity available for gradual inclusion and/or revision of certain types of data.

- Quality. It is of primary importance that the data collected and maintained be reliable and valid; data perceived to be of low quality may need to be ignored, since decisions cannot comfortably be based upon it. For example, preliminary experience with the GBF/DIME file suggest that it may be of questionable quality and only be used, if at all, with qualifications. Data acquisition

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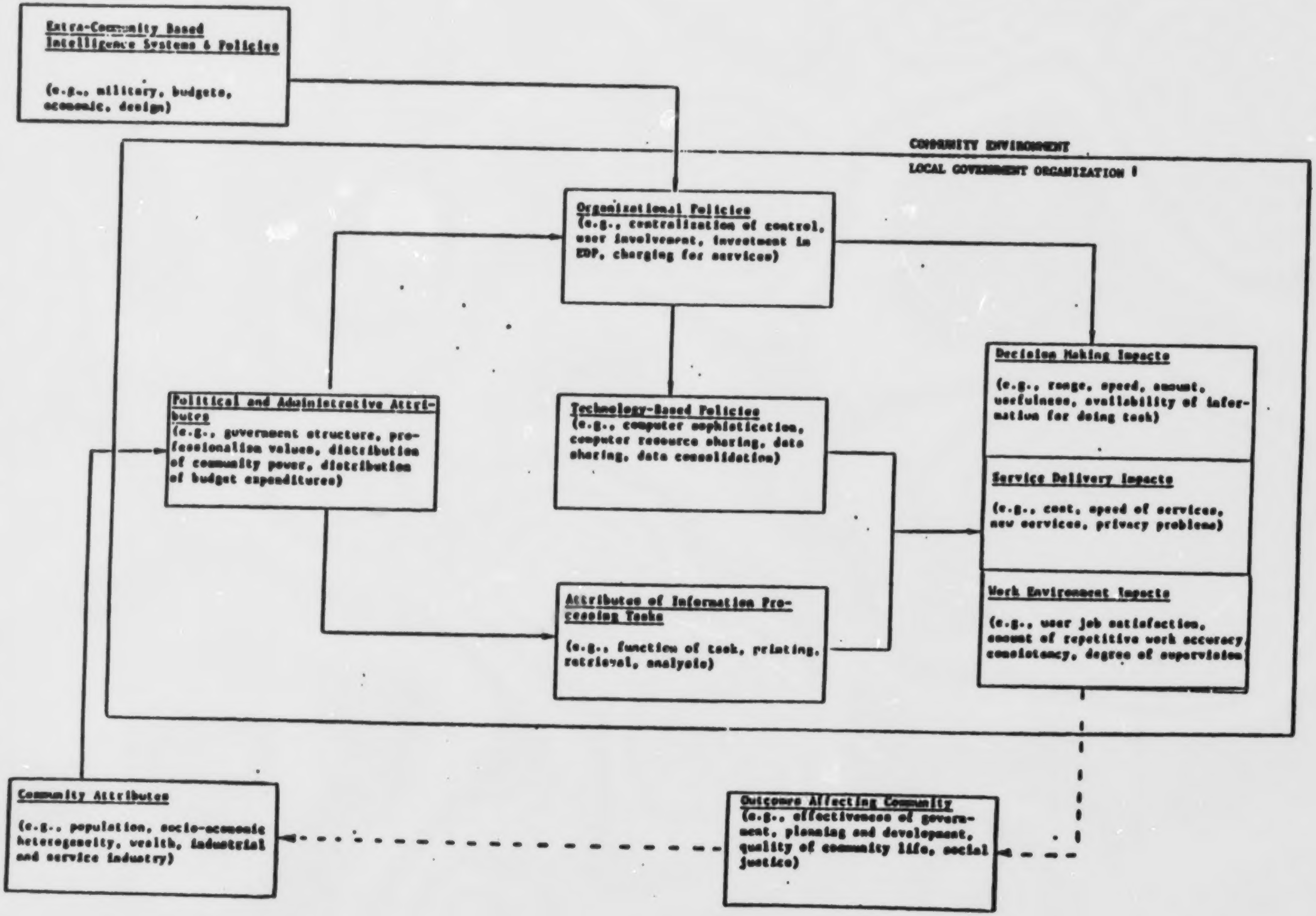
(*) Kenneth L. Kraemer, et al., "A Future City's Survey Research Design for Policy Analysis", Socioeconomic Planning Sciences, Volume 10, 1976, pages 199-211.

Exhibit 11: Framework for the Design of an Urban Intelligence System: A Generalized Model for Selection of Intelligence Technology for Planning and Development


Extra-Community Based Intelligence Systems & Policies
(e.g., military, budgets, economic, design)
COMMUNITY ENVIRONMENT
LOCAL GOVERNMENT ORGANIZATION
Organizational Policies
(e.g., centralization of control, user involvement, investment in EDP, charging for services)
Political and Administrative Attributes
(e.g., government structure, professionalism values, distribution of community power, distribution of budget expenditures)
Technology-Based Policies
(e.g., computer sophistication, computer resource sharing, data sharing, data consolidation)
Attributes of Information Processing Tasks
(e.g., function of task, printing, retrieval, analysis)
Decision Making Impacts
(e.g., range, speed, amount, usefulness, availability of information for doing task)
Service Delivery Impacts
(e.g., cost, speed of services, new services, privacy problems)
Work Environment Impacts
(e.g., user job satisfaction, amount of repetitive work accuracy, consistency, degree of supervision)
Community Attributes
(e.g., population, socio-economic heterogeneity, wealth, industrial and service industry)
Outcomes Affecting Community
(e.g., effectiveness of government, planning and development, quality of community life, social justice)

personnel must be trained to understand the need for reliable and consistent data. The system should also be as simple as possible in terms of use.

- Timeliness. In a rapidly changing environment, data must be up-to-date to be useful in supporting decision-making; moreover, necessary data should be readily available. It is therefore essential that the system yield specified kinds of output within a reasonable time limit.

- Compatibility. Data within the urban intelligence system must meet two compatibility requirements. First, data about one class of phenomena and entities within that class should be comparable with data from other classes : to meet this requirement, a single definition of data items and a unified measurement unit for data, where relevant, should be developed. Second, different data subsystems should be as compatible as possible. This is particularly important where data from different subsystems may be compared and jointly analysed as part of a strategic evaluation. A set of unified data codes must therefore be developed. The compatibility issue is particularly important where there is pressure to make the total information system conform to existing program and function-oriented systems.

- Evolutionary capability. The total system will strive for comprehensiveness. The initial "core" system will build towards this end result gradually, consistent with the stated system goals.

The process by which the "generic" system configuration becomes operational in later phases is an iterative one, which works upward from the level of individual design applications, to components, to functions, to subsystems (or sectors), to the system.

The completed systems configuration design should be documented fully to include:

- the conceptual basis for the design
- the rationalized information flow
- the points of decision
- the information requirements
- the utilisation of information
- the points and manner of input, processing, and output
- the general nature of content of the data base
- the manner in which the data base will be managed
- preliminary specification of hardware, software, consulting services, and administrative services; and
- identification of the improvements that will be required in procedures, organisational design, and personnel as the design moves forward to detailed specification and subsequent development and implementation.

3.1. Technological Choices

Interactive graphics systems can be configured around minicomputer, mainframe, or microcomputer systems. The capabilities of each kind of system, and their benefits and drawbacks, need to be assessed.(*)

Minicomputer-based interactive graphics systems have been developed as low-cost systems that package the required hardware and software for efficiently storing, manipulating, retrieving, displaying, and plotting graphic data in one system. The firms marketing these systems have developed the interfaces necessary for integrating the hardware and software components into

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(*) See Michael J. Kevany, "Interactive Graphics Systems", Auerbach Publishers, 1983.

efficiently operating systems. In some cases, vendors have developed special services to improve the processing graphics data.

One benefit of minicomputer-based systems is that many of the systems were designed and developed to be used by persons who are not computer experts (e.g. draftspersons, engineers, and map users). To facilitate use, such items as tutorial displays, command menus, and free-movement cursors have been designed into the minicomputer-based sysems. Another benefit of minicomputer-based systems is that they are often sold as turnkey systems. The term "turnkey systems" is generally applied to a complete system that includes hardware, software, maintenance, training, documentation, and support. The term also implies that all of the preceding items have been integrated so they work together. Such standard system development and implementation steps as design, programming, debugging, testing, and documentation should thus be reduced to a minimum. Ostensibly, a turnkey system can be wheeled into an office and plugged in, and work can begin in several weeks rather than months. Most important, turnkey systems provide proven hardware and software, resulting in shorter start-up times and corresponding cost savings for most users.

Large-scale computer systems, from a user's viewpoint, operate in essentially the same manner as minicomputer based systems. Technically, however, the two systems differ. A large-scale computer system is likely to be shared with other users and other types of data processing applications, while the minicomputer system is likely to be dedicated to planning applications. Processing capacity can be greater with the large-scale system, and accessibility to nongraphic attribute data may be easier if such files as an assessor's parcel file or police file are maintained in the same system; however, compatible data structures and software to link applications are difficult to develop.

From a systems development perspective, the large-scale computer system can require significantly more resources than a minicomputer-based system. The graphics software available for implementation on a large-scale system generally requires adaptation and additional programming for a specific installation. When in-house development of software is undertaken, specialised design and programming expertise is required. Developing large-scale computer systems has proven to be a complex, expensive, time-consuming undertaking; it is not recommended for local governments.

Microcomputer-based interactive graphics systems are at the opposite end of the computer spectrum from large-scale computer systems. Along with graphics' CRTs, vendors are packaging microcomputers and storage devices in order to provide low-cost interactive graphics capability.

As standalone systems, microcomputers are limited in data storage and computation capacities; however, they are being used successfully as work-stations for entering and organising data that will be transferred to a larger computer as well as for generating data displays received from a large computer system. As more micrcomputer software for planning applications becomes available, microcomputer systems will have a wider range of use within planning departments.

Distributed processing has become an accepted method of operation with equipment distributed outward from the central complex and connected by various techniques of networking.

The fundamental idea is that of the "information center" that puts the user in direct control of data, accessing information stored on the central computer as well as on other distributed machines.

This capability has extraordinary potentials. Normally, a manager has to describe his requirements to a computer professional who then translates these requirements into a program to access the files and produce the resulting report. The information center would give that manager access to the computer-based files directly, allow him to find the information desired and use it as he sees fit. A proliferation of tools is available in today's marketplace to make this happen. These are the so called 4th generation languages (such as SAS, FOCUS, RAMUS, QBE, STAIRS, APL, ADRS, OLE, INQUIRE, EASTRIEVE, CULPRIT, ROSCOE, UFO and a host of others) that make this concept a possibility.

3.2. Using Benefit/Cost to Evaluate These Systems

Once the decision is made to proceed with system implementation and a thorough justification is required, then an in-depth cost/benefit analysis is the next step. Many of the same steps taken in the initial system review process are repeated, but in more depth.

Some of the cost/benefit considerations peculiar to ICG/GIS include :

- Benefits from significant improvement in decision-making productivity

- Benefits from efficiency in such operations as producing maps at modified scales, fitting maps together, and overlaying maps

- Benefits from improved analytical capabilities

- Problems of loading the initial data base (getting all the maps loaded the first time is an extensive effort)

- Problems with in-house development costs and technical resources.

The cost/benefit analysis should also include the evaluation of alternative interactive graphics systems. If only relatively coarse mapping and generalised analysis are to be undertaken or if resources are limited, a microcomputer system can be the solution. costing as little as $10,000 (or as much as $50,000), a microcomputer system can be an inexpensive start in interactive graphics processing. If the system is selected carefully, it can be integrated into a larger system at a later date.

The simplest method of acquiring interactive graphics capability is through the acquisition of a turnkey, minicomputer-based system; a full system including hardware and software costs $150,000 to $50,000, depending on capacity, workstations, and special features.

The most complicated approach to acquiring interactive graphics capability would be in-house development of a large-scale computer-based system; even integrating purchased components is already available inside the organisation. However, using them can be a feasible approach.

A phased or evolutionary system has been undertaken by some local government organisations. Minimum capabilities are acquired initially, and additions are made to the system until a full system is installed and operating. The phased approach has the advantage of spreading the capital investment over a period of time. The disadvantage to this approach is that it may lead to operating inefficiencies and compatibility problems.

Obtaining approval for system acquisition may require more detailed analysis than a cost/benefit study. Decision-makers may want information on the successes of other local government organisations with similar systems since phased systems are a relatively new technology. A demonstration of an operational system is probably the most convincing evidence. Attempts should be made to arrange a demonstration at a nearby installation, conference, or trade show. Vendors of systems and equipment are generally quite willing to arrange a demonstration but should not be expected to bring a full system on-site.

4th Plenary Session
Friday 27 May

CASE STUDIES ON PRACTICAL USE OF METHODOLOGIES

A COMPUTERIZED INFORMATION SYSTEM FOR LICENSING A GEOLOGIC REPOSITORY FOR SPENT NUCLEAR FUEL

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1. INTRODUCTION

The U.S. Government Department of Energy (DOE) is developing an information system to support the licensing of a geologic repository for the permanent storage of high level radioactive waste and spent nuclear fuel. This system is unprecedented in the volume of information which it must handle, the duration of time over which it will be actively used and the combination of technologies that it will utilize. The national importance of the system, its size, and technical complexity have caused it to be designated as one of the Federal government's top priority systems.

This presentation is a case study about the development of this system within a large DOE program. There were no models for DOE to follow when the system concept was conceived. The theme that will be developed here is how DOE organizationally and technically moved from a concept to a system design to satisfy a vital national need.

1.1 Background

In 1982 Congress passed the Nuclear Waste Policy Act which created within the U.S. Department of Energy (DOE) an office to provide for the safe storage and disposal of high level radioactive waste generated by commercial power plants and defense production. Since the disposal of waste is a national problem the President, Congress, the States, affected Indian Tribes, DOE, and other government agencies must cooperate in the siting, design, construction and operation of this deep geologic repository. To ensure the technical viability and environmental safety of the proposed repository, DOE must obtain a license from another agency, the Nuclear Regulatory Commission (NRC), before construction can begin.

The organization created in 1982 was chartered to manage the technical and administrative elements that would lead to submission of a license application in 1995. This organization, headquartered in Washington, D.C., was scattered throughout the United States, with field offices responsible for studies on the repository sites, development of storage casks, transportation of the materials, and related scientific issues. The government contracted with nearly 2000 organizations to assist with this work. In short order, vast quantities of information were being generated as records, technical documentation and data. These were handled by diverse computerized systems used to manage the program, its projects, tasks, costs, schedules, records and data analyses. By 1985, DOE and NRC agreed that the unprecedented quantity of information that was being generated in support of the license application would be easily made accessible via computer to all parties to speed the licensing process.

Thus the concept of the Licensing Support System (LSS) was born. It was estimated that the process of characterizing the repository site would generate 25 million pages of program documentation by license submission in 1995 to be used by a variety of participants within the licensing process, including repository engineers performing technical studies, officials examining the information supporting the license application, and lawyers litigating against the proposed site. The LSS would be a computerized information storage and retrieval system designed to optimally handle these millions of documents to support the varied usages. Its design would incorporate both traditional computerized indexes to microfilmed records as well as innovative technologies such as searchable full text and bit images stored on optical disks.

As the LSS idea matured over the next two years, DOE managers began to realize that as long as the LSS remained isolated in its corner of the program and loosely tied to the mainstream of the program's work that it would be difficult to understand the LSS requirements in sufficient detail to design the system. Although they recognized this as a problem it was not an easily identifiable one with a tag around its neck giving its specifications. Rather, as the LSS concept solidified, the problems associated with it began to appear more like a ghost appearing here and there, haunting and elusive. The theme of this presentation is how we dispelled this ghost hence allowing the LSS to be set squarely within the critical program functions where it could be understood and designed.

2. INFORMATION RESOURCE MANAGEMENT

Throughout DOE there are many large and efficient computer systems and programs that assist the agency in carrying out its functions. These tend to be developed to support applications and those in charge of them are largely focused on managing the technology that supports them and the data that feed them. Our problem arose because we first needed to manage the information itself. The licensing process would draw upon information stored in many existing systems. The ghost appeared because even though, for example, the records management system or the technical data base system could be designed as model systems for their genres, there would be few clues emerging from these individual pieces of work about their relationship to the LSS. Additionally, with the profusion of office automation and microcomputers, electronic information generation began to take place directly at users' desks and not only through data processing and programming shops. Proper management of such information would include immediate input of the relevant documents into the LSS which could considerably speed the process of loading the data base.

DOE's solution was to create its first information resource management (IRM) organization within a major program. While managing information as a resource is a fashionable topic for conferences and in the literature, the complexity of such an endeavor makes it a challenge to put into practice. However an organization sets out to accomplish this, two things must happen: an environment must be created for IRM that views information as supporting the organization's mission or business and the corollary to this is that the organizational level must be adequate to provide free and easy access to the organizational decision makers. The role of the IRM manager is to provide the glue between systems and applications, to understand the underlying similarities and connections for requirements coming from diverse parts of the program, and to be able to draw upon program wide information to generate new uses for data to support the technical and decision making needs. Without this foundation, systems are designed in isolation which can lead to duplication, incompatibility and inefficiency. As diverse systems, hardware, software and applications solidified in place over time, we predicted a virtually unmanageable situation could develop thus jeopardizing the foundation for the LSS.

2.1 The LSS in the IRM Organization

Since the spectre of the LSS and the urgency for its development was the motivation for creation of the IRM organization, an analysis of the LSS vis-a-vis the program's mission provided the foundation for the organization and set the LSS soundly within it. In order to properly staff, we had to ask an orderly set of high level questions: what is the LSS, its functions and usage; do systems or models exist within government and industry that approximate those functions; what capabilities exist within the program to carry out those functions and how must they be expanded; what are the design tasks that will combine those models and functions into a cohesive whole; and finally, who can implement such a design. In the government environment, this involved hiring Federal managers, acquiring contractors with specialized technical knowledge, working with other government agencies and interested parties such as states, the nuclear utilities industries, lawyers for environment groups and the public. This process of translating the problem definition into tasks and resources to address these tasks began to define the LSS. We were getting closer to having a problem that did have an identification tag around its neck that we could trap and dispell.

2.2 The IRM Functions

Formally the IRM organization was chartered to provide policy direction and technical support to all program entities generating and using information as well as for the technologies supporting them. What this meant in reality was that we had the authority to impose standards for hardware and software as well as procedures across our nationwide program thereby building a foundation upon which information could be managed and systems developed.

The first task was to write a Program Plan. It delineated the information needs by analyzing the business enterprises involved in carrying out the Program's mission, as shown at a high level in Figure (1), and introduced strategies and methodologies for incorporating technology to meet these needs. The Program Plan then recommended a series of implementation plans, complying with applicable laws and regulations, which set forth procedures and standards which exhaustively covered the facets of IRM:

- Data Administration
- Office Automation
- Records Management
- Telecommunications
- Technical Data Management
- Program Management
- Software Management
- Documentation

To proceed from an implementation plan to its execution requires yet another facet of the IRM process: effective management through systems engineering including cost accounting and project scheduling. With the number of contractors and tasks underway, it was essential to put good controls in place, but to do so in such a way as to define base capabilities that would be expandable as new systems were defined. The work breakdown structure (WBS) that was devised is shown in Figure (2). The LSS design must incorporate the basic technological and management functions defined as elements of the WBS, and expand these to meet the specialized LSS performance requirements. For example, the optical disk pilot project was undertaken to answer questions about the viability of this technology for the LSS. The answers obtained and the actual technology introduced for the LSS will then be available to other systems as part of the program's technological base.

3. THE LSS

The LSS in the broadest sense is (1) a set of procedures for guaranteeing optimal access to the maximum amount of information relevant to a set of factual issues regarding the suitability of the proposed repository site and design, except where access is limited by law and (2) the technological means employed to implement these procedures. It is a bibliographic or textual system into which

PROGRAM FUNCTIONS

OPERATIONAL SEGMENTS	MAJOR ACTIVITIES
Management	Project
	Business
	Administrative
	Quality Assurance
	Information Resources
	Operations
	Facilities
	Materials
	Maintenance
Technical	Scientific
	Engineering
	Environmental
	Quality Control
	Configuration Control
	Performance Assessment
Regulatory	Licensing
	Litigation
	Public Information
	Consultation Cooperation
	Intervention
	Congressional Interactions

Figure 1 Jan 88

WORK BREAKDOWN STRUCTURE

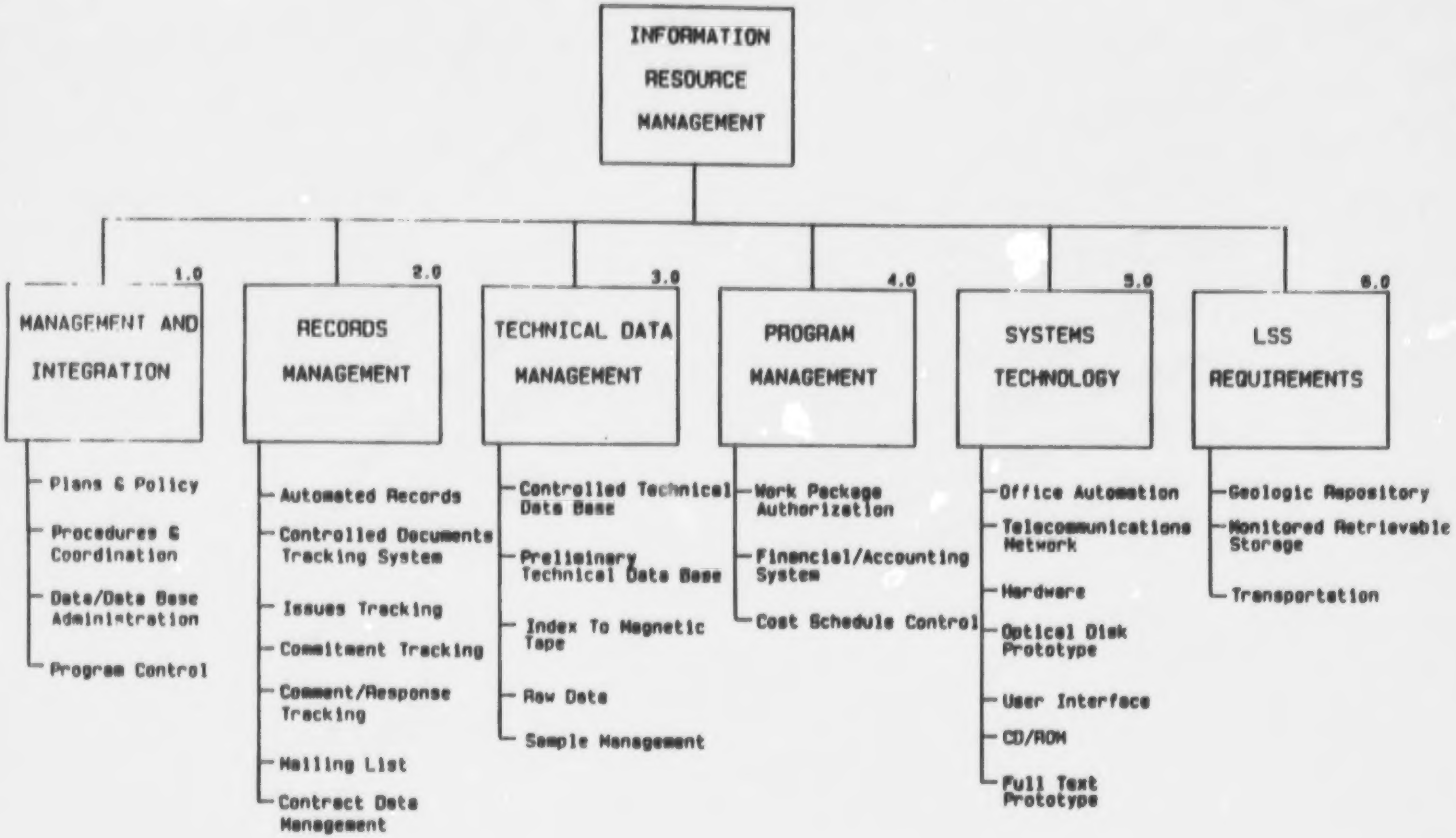
INFORMATION RESOURCE MANAGEMENT
1.0
MANAGEMENT AND INTEGRATION
Plans & Policy
Procedures & Coordination
Data/Data Base Administration
Program Control
2.0
RECORDS MANAGEMENT
Automated Records
Controlled Documents Tracking System
Issues Tracking
Commitment Tracking
Comment/Response Tracking
Mailing List
Contract Data Management
3.0
TECHNICAL DATA MANAGEMENT
Controlled Technical Data Base
Preliminary Technical Data Base
Index To Magnetic Tape
Raw Data
Sample Management
4.0
PROGRAM MANAGEMENT
Work Package Authorization
Financial/Accounting System
Cost Schedule Control
5.0
SYSTEMS TECHNOLOGY
Office Automation
Telecommunications Network
Hardware
Optical Disk Prototype
User Interface
CD/ROM
Full Text Prototype
6.0
LSS REQUIREMENTS
Geologic Repository
Monitored Retrievable Storage
Transportation

Figure 2

Jan 88

all parties to the licensing hearing including DOE, affected states, national environmental groups, nuclear utility industries and other interested parties will enter their information and to which they will have access.

Figure (3) shows a rather traditional display of a system life cycle development. Past experience has proven that this approach works and has led to viable systems. However, there was an additional wrinkle involved in defining the requirements for the LSS. Legislation mandated that the licensing hearing be completed in three years which is an unprecedentedly short length of time. In order for the LSS to succeed, it must not only meet the user requirements for maximum retrieval of relevant information, but it must mitigate the normal delays associated with examination of materials submitted to support the license application and with document discovery as part of the legal process. An analysis showed that these activities carried out in a traditional way would lead, at a minimum, to a five year license.

This added a new twist to the information resource management problem, and took us outside our newly created IRM organization. If the technical people could recommend hardware and software solutions to speed these processes, would the user community accept them since different parties had different agendas? While the officials in the licensing agency and DOE engineers would embrace the most efficient system to speed their work, the lawyers litigating against the construction at the site might see delay as aiding their cause. Two courses of action were undertaken. The first was to gather all the parties together and gain agreement as to the conditions under which they would all pledge to use the system. They specified what they considered to be information relevant to them, the form it had to be in and what times would be acceptable for production and delivery of it. Additionally, and most importantly, they agreed to do business in a new way where they would examine issues and the related documentation prior to the license hearing. In parallel, the technical people asked the question as to whether any type of automation could sufficiently facilitate these processes to lead to a three year license.

To give some idea of the magnitude of the undertaking, it is interesting to note that with a volume of 25 million pages (which equals 5 million documents), it would take 2 man years to search manually through them to answer one query. Even if the collection could be segmented into 40 issue-related categories (unlikely since multiple issues can be discussed in one document) it would then take 26 days to answer one query. Computerized indexes would speed the process of searching, but it would still be necessary to locate the hard copy or microfilm.

3.1 Migration to the LSS

Records management was already part of the program's basic information management. This was a traditional bibliographic system with computerized indexes to the microfilmed records. These "surrogates" include author, title, subject and other information vital to retrieval. The documents that would be in the LSS had to be a subset of these records, since we were capturing all documentation generated and received by the program. However, there would be differences. The LSS would be needed between now and 1998, while the records system must retain program records until repository closure in the middle of the next century. More significantly, the usage groups that we identified consisting of technical specialists, licensing officials, lawyers and the public could all require a different perspective on the same material, and that could be yet different from the basic indexing adopted for the records system.

To return to Figure (3); it was the analysis of user needs in the early stages of the system life cycle that uncovered these different forms in which the information would be required. Then an analysis of the scope and magnitude of backlogged, current and projected program documentation gave volume projections for different categories such as correspondence and reports. These studies led

INFORMATION SYSTEM LIFE CYCLE

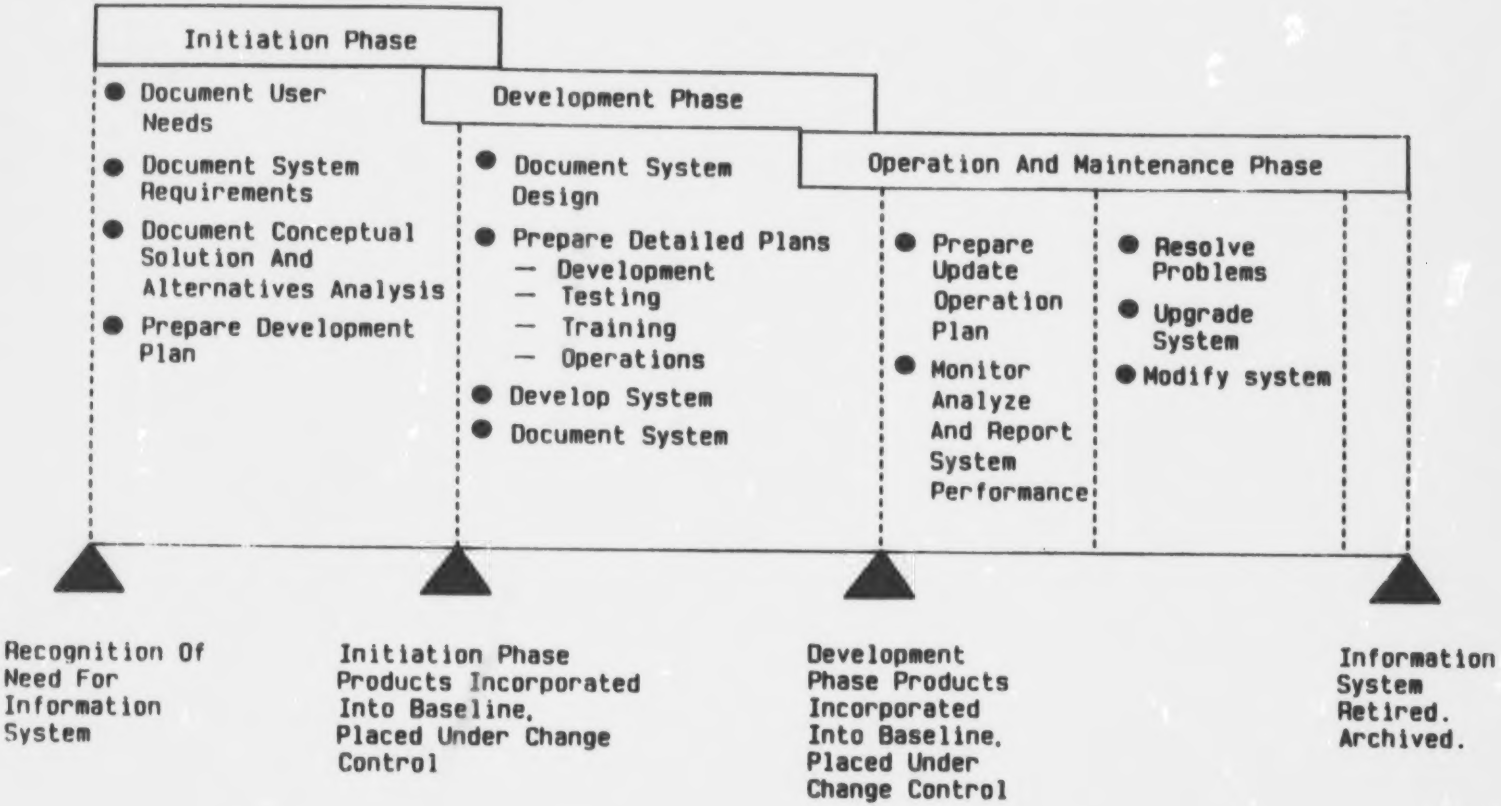
Initiation Phase
● Document User Needs
● Document System Requirements
● Document Conceptual Solution And Alternatives Analysis
● Prepare Development Plan
Development Phase
● Document System Design
● Prepare Detailed Plans
— Development
— Testing
— Training
— Operations
● Develop System
● Document System
Operation And Maintenance Phase
● Prepare Update Operation Plan
● Monitor Analyze And Report System Performance
● Resolve Problems
● Upgrade System
● Modify system
Recognition Of Need For Information System
Initiation Phase Products Incorporated Into Baseline. Placed Under Change Control
Development Phase Products Incorporated Into Baseline. Placed Under Change Control
Information System Retired. Archived.

Figure 3

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to differential indexing by categories of information for the different user groups, and the provision of concrete sizing specifications to the systems designers.

The primary criteria for performance of the system called for completeness of retrieved information and timeliness of delivery, and these led to two technological solutions that were unique in their cojoining: full text indexing and optical disk storage.

3.1.1 Full Text Indexing

While bibliographic references would suffice in some cases, requirements called for a certain segment of the program information to be entered into the computer and be retrievable in its full text form. Full text indexing consists of creating an electronic copy of the document, reading it into appropriate retrieval software and automatically indexing the page, paragraph, sentence and line position of every significant word in the text. No distinction is made between radioactive waste as a title phrase or a textual subject. The advantages of full text are two fold. First, it provides access to every word of the text as the user wishes. In surrogation, the terminology might be at a more general level, forcing inspection of all documents relating to the general level in order to find those at a more specific level. Secondly, if a document is created on a word processor, it can be read directly into retrieval software and made available for searching very quickly. The surrogation process is time intensive since it takes human indexing, review, and conversion to machine readable form. It is estimated that the indexing of 5 million documents using a staff of 60 would require 4.5 years.

Nevertheless, full text indexing has some inherent drawbacks. It is most effective when the language of the text is precise, consistent and standard. In this program the documentation ranges from engineering reports, where full text retrieval would be expected to be quite high, to socioeconomic issues where the language is less precise. So we are still providing some level of surrogation in addition to the full text treatment for those documents that warrant this care. This surrogation can also be useful to narrow the set of documents that are retrieved by the computer search. If a very broad term such as ground water is entered into the search strategy, thousands of documents could be retrieved. The surrogates can be used, for example, to find only those documents where ground water is a major subject, and then the full text of that set can be searched in more depth.

3.1.2 Optical Storage of Images

The second criterion driving the design was the need for timeliness of delivery of information. We found this criterion to be nonlinear over the period of time from now to the end of the hearing in 1998. Microfilmed documents of much of the past work are perfectly adequate since there will be so much time to examine them before the hearing starts in 1995. Those that will be needed during the hearing must be available very rapidly, whether they have just been produced or were produced two decades ago. In order to expedite the delivery of such documents, they will be scanned onto optical disks. The image, or exact representation of the document, will be stored on this medium, rather than on microfilm, leading to interesting possibilities in the delivery of documents.

A typical session could go as follows.The full text or the index to the document is searched and then the document itself is requested. The searchable full text version, of course, does not contain graphics or signatures or marginal notes that might be of interest. The accession number in the index will point to the address on the optical disk, the disk will be accessed and since the image exists electronically as a string of bits, the image can be printed on a laser printer. This copy can be used locally or mailed to a remote user. If the timeliness is urgent, it will also be possible to transmit both the text and images of short documents, or sections of larger ones electronically over communications lines to other parts of the country.

3.1.3 The Prototype

In terms of Figure (3), we are still in the initiation phase. The development of possible alternative configurations involves both the information work described above and some experimentation with technological solutions. The LSS is larger than any current system if all the information is searchable simultaneously, while if its broken into files or distributed geographically in the offices that produce it the problem becomes much more tractable. There are systems already in place as part of the basic program capabilities that handle millions of pages of information. It is vital to understand the limit of these capabilities given the requirements of the LSS and what techniques and technologies must be used in addition to or instead of what is currently in place.For example, at what point does search performance degrade because of the quantity of information or the number of simultaneous users or the complexity of the queries. It is also difficult to really converge on requirements if the proposed system is technologically beyond what any of the interviewees has ever used.

The approach we took with building a prototype was to move much of the processing power to the desktop and to link those desktops into one cohesive network regardless of geographical location. Since the goal of the prototype is to test technological capabilities and ferret out user requirements, this workstation approach will provide answers without dictating a final system architecture. Functions can be centralized or decentralized in the final design; more or less can be done at the workstation. This technology was chosen since the capabilities of workstations are expected to increase while costs decrease during the implementation and operational phases of the LSS.

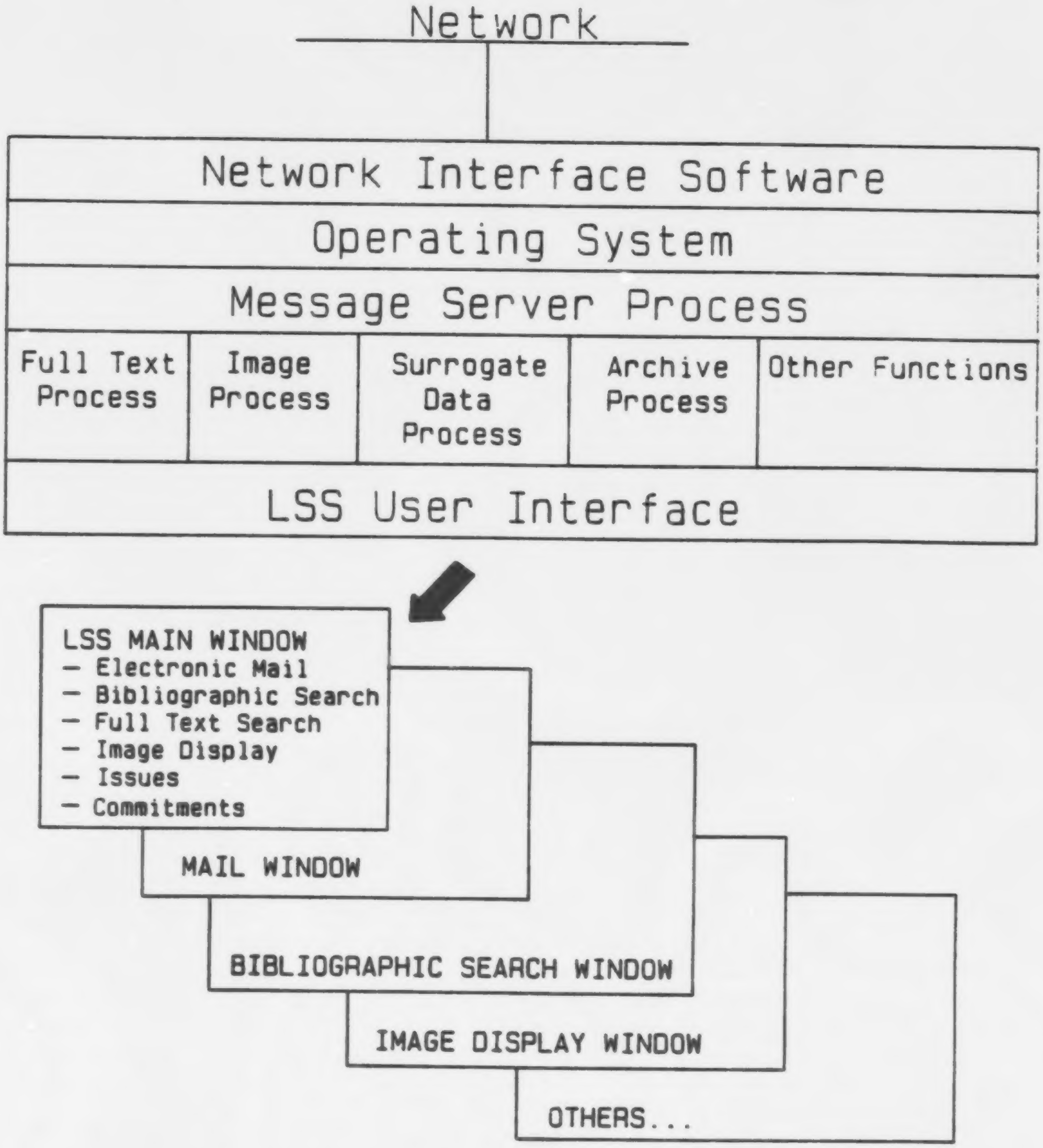
Figure (4) shows an architecture that is built upon the availability of high performance, multitasking, windowed user interface, desktop computers with high resolution monitors and high bandwidth communications capability. Each of the geographically dispersed project sites and the Washington, D.C. headquarters will have a local prototype configuration consisting of a server for electronic mail and bibliographic searches or surrogate data; multitasking workstations capable of image decompression and display, a full page high resolution display and a laser printer; a full text search server; and an optical disk juke box for image storage, all networked together. The sites are then interconnected by bridges, or intelligent connections, which route traffic out of its local area network if the destination address is not local.

3.1.3.1 The Workstation

The high performance desktop workstation can provide the LSS user with a man- machine interface far superior to any mainframe, and a much more responsive tool. Although network loads and queueing effects at the servers will impact response time, decreased response time can be expected from off loading functionality from the servers which can be mini- or mainframe computers. The key to a workstation-based system is the multitasking capability. The user is presented with a set of windows for all the functions as indicated in Figure (4). Each function is a workstation task which requests resources from the workstation operating system to either process the request in the workstation or route the request to the server over the network.

A typical LSS user might log into the workstation, start a large search or image transfer in those windows, be given an estimate of five minutes to complete and told that he will be notified when that operation is completed. While a five minute wait would be intolerable in many systems, the multitasking capability greatly affects user perceptions of the LSS system speed. The user can switch to other functions such as reading and sending electronic mail or checking on outstanding

WORKSTATION SOFTWARE HIERARCHY



Network

Network Interface Software

Operating System

Message Server Process

Full Text Process

Image Process

Surrogate Data Process

Archive Process

Other Functions

LSS User Interface

LSS MAIN WINDOW
- Electronic Mail
- Bibliographic Search
- Full Text Search
- Image Display
- Issues
- Commitments

MAIL WINDOW

BIBLIOGRAPHIC SEARCH WINDOW

IMAGE DISPLAY WINDOW

OTHERS...

- Users move between windows with mouse and keyboard commands

Figure 4

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issues while the search operation is in progress. When it is complete, the user could switch back to the search window to find the search statistics displayed, and perhaps the text and images transferred to the workstation disk.

The workstation software can be developed as a set of modules for each of the functions, plus other modules which pass messages to the servers and cache the results. This means that the system can be coded in parallel and the same workstations can be used for development and integration testing. The user interface can be rapidly prototyped and the other functions simulated within the workstation. Over the years, as additional features are required, or the desktop capability increases, more functionality can be moved to the workstation and off the mainframes. At this point in time, we estimate the LSS will require 50 workstations, and it will be possible to acquire approximately 150 MIPS of computer power for under $1,000,000.

3.1.3.2 The Servers

All servers receive requests from the workstations as operation codes and return data. The image server is a multi-user, multi-tasking computer which front-ends with a bank of individual optical disk drives or an optical jukebox. The codes sent to the server are mainly accession and page numbers and the data is stored as compressed images on the disks. The images are retrieved from the optical drives, cached on magnetic disks, and sent to the workstations via the network. The image server can also be requested to print at the server for subsequent delivery to the requestors. These different capabilities for delivery can then very precisely meet the requirements for timeliness of delivery of information.

The full text server can be a full text engine, that is, a hardware solution, or a database management system, that is, a software solution. It must be able to perform multiple multi-term searches simultaneously and additionally return the full text for a document immediately given the document accession number. This later capability allows the user to perform a bibliographic search on the data base management system on that server, and then pull the text of the document into the workstation. The workstation can then perform further processing locally such as searching for a given page or printing the document.

3.1.3.3 Prototype Test Results

By the end of 1988 we expect to test the prototype LSS with a relevant 100,000 page document data base by letting users query its surrogate and full text capabilities and display the images and text of the retrieved information. We will document the experience of the various users and determine the implications for the design of the operational system. We believe that the definition of user requirements obtained through interviews will be validated and affirmed- or rejected- by this hands-on experience. The tests will include representative searches by the various known user groups which will enable us to understand the search strategies employed and the results obtained.

System performance tests will include scanning documents to translate them into bit images as well as tests with optical character readers that capture document text in a machine-readable format directly from hardcopy. Performance statistics on the information aspects of the system will include query complexity as related to system performance, effectiveness of indexing methods and delivery times for electronic and hardcopy versions of the retrieved information.

At the conclusion of the prototype tests, we believe we will have an understanding of the design parameters which must be incorporated with the LSS, not as abstractions but based on actual usage.

4. CONCLUSION

The LSS grew out of a need to handle a vast quantity of information for a diverse audience to meet the goal of a three year license that would have been unobtainable before the current maturation of the computer age. While the problem demands that we utilize hardware and software capabilities at the very edge of technological possibility, the experience gained thus far from the LSS project showed us that the goal could not be met by technology alone. A complete understanding of the requirements of the LSS could only emerge when the system was perceived as one of the critical elements of the program and this perception was institutionalized through an organizational structure.

The LSS is a specialized application building upon and migrating from the current systems and procedures. In 1998, when DOE has authorization to construct the geologic repository, the LSS in its present form will have served its purpose. However, the technologies and procedures that were added to the base program capabilities as well as the information itself that was captured and indexed will form the basis for the archives and for the next migration. As the LSS began with a subset of program records treated appropriately for its needs, requirements are then expected to surface for a subset of the LSS that will form the core of a new system to document the construction phase of the repository. The organizational and technical foundations that have been established should smooth the way for these future transitions.

EXPERIENCE IN PRACTICAL USE OF METHODOLOGIES FOR PLANNING GOVERNMENTAL INFORMATION SYSTEMS

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INTRODUCTION

There are two threads that run through the content of this conference and of this paper. First is the effective use of a class of machines: computers and ancillary devices for data input, output, and communications. These machines and devices are becoming more widespread, operating faster, and growing cheaper - trends that are sure to continue. Second is the marshalling of increasing volumes of data, both to describe the economy, and to yield insights into understanding and managing it. These two threads are intertwined at many points in the fabric of public administration, and their interconnections are increasing. The term "information system" provides a conceptual nexus for looking at these threads and their linkages together.

In this paper we examine experience in the practical use of methodologies for planning information systems to support governmental agencies. We will address four broad topics:

- Perspectives
- Methodologies
- Experience
- Lessons.

1. PERSPECTIVES ON INFORMATION SYSTEMS

Where one stands on the use and merit of various methodologies for planning information systems depends significantly on where one sits, i.e., on one's perspective. Computer-based information systems can be seen from the perspective of at least four different categories of persons:

- Illuminators
- Administrators
- Automators
- Methodologists

Persons can have more than one perspective, but one usually dominates. A government official wants more and better data to illuminate a sector or region of the economy so he can deal with it more effectively. An administrator seeks more efficiency or productivity in bureau operations by using computers. Meanwhile, an automator may want to use a particular hardware component or software package; the content and use of the data manipulated thereby is of lesser interest to him. And this conference has a heavy methodological flavor - we are trying to distill from the experience of various countries the usefulness of methodologies for systems planning.

Within these perspectives, one should be sensitive to the criteria - some implicit, to be sure - that each of us brings to evaluating various methodologies. For some, a principal criterion is to be modern and seek "state-of-the-art" approaches in technique and technology, sometimes almost as ends in themselves.

By contrast, some people are inclined to be cautious, not only to look before they leap, but to look very carefully and then proceed with system design in small steps, not large leaps. This "incrementalism" often comes at a cost, especially in systems serving large organizations such as decentralized governmental bureaus where distributed networks or telecommunications systems could be beneficially installed.

For those who would be thrifty, care should be taken to plan for the costs of both creating and operating systems and to consider the costs of the information systems that bring data to and take them from the computer as well as the computer systems themselves. The criterion of being comprehensive - a particular inclination of many governmental officials - is laudable conceptually but often troublesome operationally. If one seeks too broad a scope, the dangers of paralysis from analysis grow, and the need to obtain agreement among many and diverse parties can thwart implementation. Thoughtful balance among these criteria provides the path to successful system design.

With these perspectives and criteria as a framework, let us now turn to methodologies for planning governmental information systems.

2. METHODOLOGIES

To understand various methodologies, both definitions and taxonomies are needed.

First, "methodologies" means a collection of methods or tools into a systematic approach to system development. Such methodologies are applied within those portions of the system life cycle normally defined as system analysis, system design, and system development. (1)

Secondly, two taxonomies of system methodologies can be useful. The first consists of three classes:

- Top-down structured design, which concentrates on processes or functions to be performed by the system, as seen from a hierarchical perspective.
- Data structure design, which focuses on the data to be handled within the system.

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(1) The term "computer-aided software engineering" (CASE) applies to a similar portion of this life cycle. The U.S. market for CASE products (i.e., methods and tools) is estimated in the $1 billion range annually. (Digital Equipment Corporation, "Computer Aided Software Engineering, A White Paper", 1987).

. Object-oriented development, which deals principally with collections of objects with which the system is concerned. (2)

A second taxonomy, followed in the 1982 Working Conference on Comparative Review of Information Systems Design Methodologies, defines two classes: process-oriented and data-oriented. (3) These are similar in concept to the first two classes in the prior taxonomy.

Most methodologies cannot be fitted neatly into any single class in either of these taxonomies. This is because most documented methodologies are continually changing as they are enhanced and applied. Hence assigning particular methodologies to particular classes is sure to be controversial. Nevertheless, two of the more widely-used methodologies, Yourdan-deMarco and Warnier-Orr, fit broadly into the "process-oriented" and "data oriented" classes, respectively.

3. EXPERIENCE

With this general understanding of methodologies for planning information systems, let us turn to two cases of experience with real systems.

Case No. 1

A government agency issued terms of reference for a large social insurance processing system. The terms called for use of a specified design methodology. My firm was chosen to perform the work, but we raised concern about the exclusive use of the specified methodology because it had never been tested on such a large system. The agency insisted that it be used, but agreed to an evaluation of the results when the design was completed. The methodology generated thousands of pages of largely redundant descriptive detail and led to a system design and document maintenance requirement so burdensome that the system cost was double the initial estimate.

Case No. 2:

Another assignment for a very large mortgage institution was to fully automate all home mortgage activities for the 650,000 loans in the institution's portfolio. Several factors contributed to the selection of methodologies employed in this large project. Foremost among these was the existence of a vintage-1960 system which could be used as a technology base to extrapolate current needs. However, given a lack of a documentation baseline and a shortage of systems analysts familiar with relevant government regulations, management decided to document the data structures associated with the business so that basic understanding could be attained. To that end, the Warnier-Orr methodology was used to analyze and define basic system concepts.

Approximately one year later, as the system analysis stage was being completed, management decided that more rigid methodologies were needed for system design. Six months were invested to develop a custom methodology to meticulously detail each process of system implementation. The methodology was loosely based on the Warnier-Orr foundation in place and furthered the data-centered approach which had been followed through the analysis effort.

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(2) Booch, Grady. "Software Engineering With ADA". 2nd Edition. Benjamin-Cummings Publishing Co., Inc., 1987, p. 36.

(3) Olle, T.W., Sol, H.G., and Verrijn Stuart, A.A. "Information Systems Design Methodologies: A Comparative Review". Amsterdam: North Holland Publishing Co., 1982, p. 3.

Once the new methodology was employed, however, significant problems arose. Changes in the mortgage business focused management's attention on the problem of change management at the data level. It became apparent that "process", not "product", was driving system development. While system developers were dutifully following the custom methodology, the end result was rarely documented in consistent format. In the face of increasing scope and changing detailed data requirements, system developers were without top-down design methods allowing rigid quality control and configuration management to govern top systemic structures while data structures solidified.

As the above circumstances surfaced, product documentation standards were developed to mandate format and content of engineering products (e.g., Top-Level Design Specifications, System Operating Concepts) as distinct from the engineering process. What was once an ordered, non-automated discipline became a structured methodology supported by process automation. Emphasis shifted to product content, allowing management discretion in process and method. (Indeed, the process-oriented emphasis shifted from data-driven to a Yourdon-type top-down structured design approach.) As the project evolved, management adopted a phased implementation strategy to provide for partial system operations before the entire system is fully in place.

4. LESSONS

Some of the lessons from these cases and other experience in using methodologies for planning information systems arise from what has been learned over the past three decades in introducing computers into government operations of all kinds. These lessons are worth repeating in the context of this conference because they are profound and fundamental. Other lessons grow out of more recent experience with the use of newer methodologies.

Lesson 1: Allow liberally in planning governmental information systems for the costs and changes that will be necessary outside the computer system to enable the computer system itself to perform its role effectively. These costs and changes will often impact bureau procedures, staff and customers.

Lesson 2: Plan for "human problems", because many of the individuals involved in systems planning and operations will not perform as anticipated. Some will prove able to accept the roles called for by the computer system, others will not. The provision for "recovery and restart" is as important for personnel plans as for computer programming.

Lesson 3: In planning a governmental information system, adopt a principal implementation strategy, keeping in mind the perspectives and criteria noted earlier in this paper. Alternative strategies are: (1) Phased implementation, often with a period of operations provided at the conclusion of each phase; (2) "Great Gulp" implementation, in which the entire system is moved forcefully from concept to operations without pauses; (3) Prototype development, in which the contemplated system is developed and tested in miniature before full-blown implementation is launched (a strategy suitable only for certain controlled situations). None of these strategies is intrinsically the best in all cases, but one of them should be clearly in place to guide system development.

Lesson 4: Methodologies are usually more useful to describe and analyze the present system than to creatively design a new system that will meet users' real needs. Human creativity remains paramount as the principal ingredient in successful system implementation, although this creativity can be fruitfully framed by the standardized design and document content specifications that methodologies require. However,care should be taken to minimize the excess of descriptive documentation that some methodologies can generate.

Lesson 5: Recognize that no single methodology works best for all projects or for all phases of a single project. Given the rapid evolution of computer system methodologies, an eclectic approach will often serve the organization best, provided one has skilled and seasoned staff to make the selections. In particular, be sure that the methodology used is suitable for the scale of system to be designed.

Lesson 6: Even though an initial direction has been followed with a particular methodology, modifications in the direction and the methodology to meet evolving project needs (a) should be expected, and (b) can often be accomplished without damaging project success.

Lesson 7: Focus on products is more important than rigid adherence to a particular system design process.

Lesson 8: Do not expect that a methodology alone will produce a system or manage the system development process. Continuing, attentive project management that is alert to evolving changes is essential to producing a system that satisfies the users at reasonable cost - be these users illuminators or administrators.

5. CONCLUSION

We may conclude that experience in practical use of methodologies for planning governmental information systems teaches us that these methodologies are

- Diverse and rapidly changing.
- Useful, especially in system description and analysis.
- Insufficient in themselves for design of systems that will fully serve user needs.

As we have learned in other areas of management and technology, the human contribution remains paramount to project success.

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LONG RANGE INFORMATION SYSTEMS PLANNING IN THE SINGAPORE GOVERNMENT

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National Computer Board
Republic of Singapore

BACKGROUND

Singapore

Singapore was a former British colony and later, a Malaysian state. It became an independent republic in 1965. About 2.63 million people comprising Malays, Chinese, Indians and other races live in an area of 620 sq km. The average life expectancy at birth is 71 years. The literacy rate of the population is estimated at 86%. In 1987, the GNP per capita was about US$7,850. In terms of computer usage, Singapore has 0.3 framework and mini computers per thousand population and an information technology expenditure of US$96 per thousand population (compared to 1.5 and US$72.40 respectively for Japan) (1).

The Government

Parliament consists of a single legislative chamber(with 79 members elected by the people in single member constituencies. Judicial power is vested in the Supreme Court and Subordinate Courts. The judiciary administers law independently of the Executive. The President, who is elected by Parliament, appoints a Member of Parliament as Prime Minister. There are currently 13 ministries, each headed by one or more ministers.

The Civil Service has about 70,000 employees, or about 5% of the total work force, in the ministries and organs of state. In 1987, total government expenditure totalled US$6,250 million, nearly one third of which was development expenditure.

The National Computer Board

The National Computer Board (NCB) was formed by an Act of Parliament in September 1981 as a Statutory Board under the Ministry of Finance. Its mission is to drive Singapore into the information age. NCB's role is to promote the exploitation of information technology (IT) in Singapore to improve productivity and enhance business competitiveness in the various economic sectors; and to develop a strong and viable export oriented IT industry. One of NCB's major functions is to encourage, manage and implement computerization in the Civil Service.

Singapore has formulated a National IT Plan as an integrated strategy to full exploit the potential of IT. The NCB has given the responsibility of a central co-orindation agency in the implementation of this plan which aims to :

a) Produce high quality IT MANPOWER

b) Promote a supportive IT CULTURE

c) Maintain an excellent INFORMATION COMMUNICATION INFRASTRUCTURE

d) Encourage widespread IT APPLICATION in all sectors

e) Build a strong IT INDUSTRY

f) Develop a CLIMATE FOR CREATIVITY AND ENTREPRENEURSHIP, and

g) Forge close CO-ORDINATION AND COLLABORATION among all relevant agencies to achieve unity of purpose.

HISTORICAL PERSPECTIVE OF GOVERNMENT COMPUTERISATION

The Civil Service started computerisation in 1964. Prior to the formation of the NCB in 1981, the Civil Service adopted a centralised approach to computerisation. Most government ministries relied on a central department for data processing (dp) services. Under this approach, computerisation progressed at a relatively slow pace as the central dp department had insufficient professional resources, skills and technology to cope with the varied and growing demands of its users. Consequently, there were many unhappy users and a big backlog of systems to be developed.

The Committee on National Computerisation (CNC) chaired by the then Senior Minister of State for Education, commissioned a study in 1980 to look into the long term computerisation requirements of the Civil Service and to recommend an action programme for its implementation. The study was carried out concurrently by several teams, comprising data processing professionals, management services officers and senior officers from the various ministries. This was the start of formal information systems (I/S) planning in the government ministries. Each team mapped out a long range I/S plan to meet the organisational objectives of ministry studied. The results of their studies and their recommendations were published in 1981 and subsequently accepted by the CNC.

This led to the formation of the NCB and the formulation of the Civil Service Computerisation Programme (CSCP). The CSCP, which was launched in the end of 1981, is a multi-million dollar programme to promote the use of computers and implement computerised information systems in every government ministry. The initial scope of the CSCP covered 89 application systems in 10 ministries. The CSCP was, however, to be an evolving programme. It expanded in scope to cover new application areas within ministries and to new ministries, and extended to continually exploit opportunities presented by new and emerging technologies. Today, the CSCP has 58 mainframe and mini cimputers manned by 385 NCB professional staff spreading over 32 installations and project sites. 126 applications have been implemented and another 185 have been identified for development in the next 5 years.

The CSCP was to spearhead the national computerisation effort and demonstrate the government's st'rong commitment to computerisation in the early eighties. The programme was conceived with the following objectives :

a) To increase the productivity and effectiveness of government operations

b) To improve the quality and range of government service to the public

c) To create interest and promote computer usage in other economic sectors through the operation of new and very visible computerised systems in the Civil Service.

INFORMATION SYSTEMS PLANNING (ISP)

A simplified version of IBM's Business Systems Planning (2) was used in the first long range I/S planning efforts in the ministries commissioned by the CNC in 1980. Since then, ministries are required to conduct such planning exercises before embarking on major computerisation projects. Over the years, we have revised and improved our methodology for long term I/S planning. This was in response to feedbacks received on the use of the methodology, emergence of new I/S planning tools and changes in government procedures for approving funds for computerisation in the ministries.

The current NCB ISP methodology incorporates some of the tools and techniques from the following methodologies and concepts :

a) IBM's Business Systems Planning (BSP)

b) Information Engineering (3)

c) Data Modelling using Entity - Relationships Diagrams (4)

d) Critical Success Factors (CSF) Method (5, 6)

e) Cost Benefit Analysis using Discounted Cash Flow (7)

THE NCB ISP METHODOLOGY

Presently, our ISP methodology consists of 8 major tasks as shown in Figure 1.

The activities in each task are summarised below.

Task 1 : Organisation's Mission, Objectives, Strategies and Initial Data Model

a) Define mission, objectives and strategies of the organisation.

b) Identify key and supporting resources, and the products, services, channels and markets of the organisation.

c) Develop initial organisation-wide data model using the outputs from (a) and (b). Data modelling includes defining the data entities, entity-relationships and data attributes of each entity. (See Figure 2).

d) Decide the organisational structure.

Task 2 : Manager's CSFs and Information Requirements

a) Identify CSFs by interviewing senior managers. CSFs are the key areas of the business in which high performance is necessary if the organisation's objectives are to be met.

b) Determine key measures of CSFs.

c) Identify other information and reports required by senior managers for decision making.

d) Consolidate and prioritise the CSFs and managers' information requirements.

INFORMATION SYSTEMS PLANNING METHODOLOGY

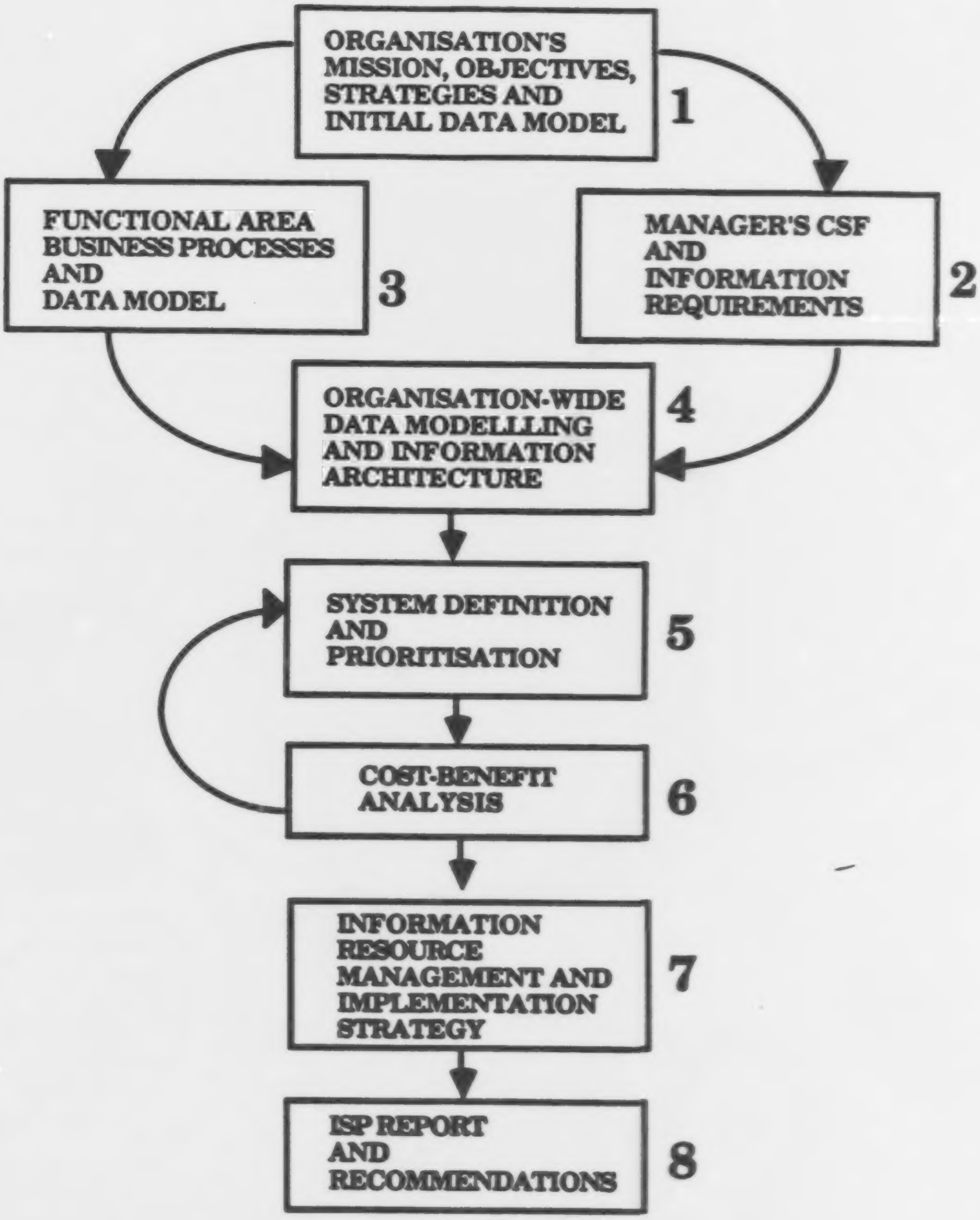

ORGANISATION'S MISSION, OBJECTIVES, STRATEGIES AND INITIAL DATA MODEL
1
FUNCTIONAL AREA BUSINESS PROCESSES AND DATA MODEL
3
MANAGER'S CSF AND INFORMATION REQUIREMENTS
2
ORGANISATION-WIDE DATA MODELLLING AND INFORMATION ARCHITECTURE
4
SYSTEM DEFINITION AND PRIORITISATION
5
COST-BENEFIT ANALYSIS
6
INFORMATION RESOURCE MANAGEMENT AND IMPLEMENTATION STRATEGY
7
ISP REPORT AND RECOMMENDATIONS
8

Figure 1

DATA MODELLING

- **Entity** : A Thing. Eg Product
- **Attribute** : Description of a Thing. Eg Product Number, Product Description, Price.
- **Relationship** :
  - Logical linkage between two things. Eg An order contains products.
  - Based on business rules. Eg An order may contain one or more products. A product may appear in one or many orders.
- **Data Dictionary** : Specification of attributes in each entity. Eg PRODUCT : (Product Number #, Description, Price, Stock).
- **Data Model** : Schematic Representation of Data Entities and the relationship between these entities. Eg

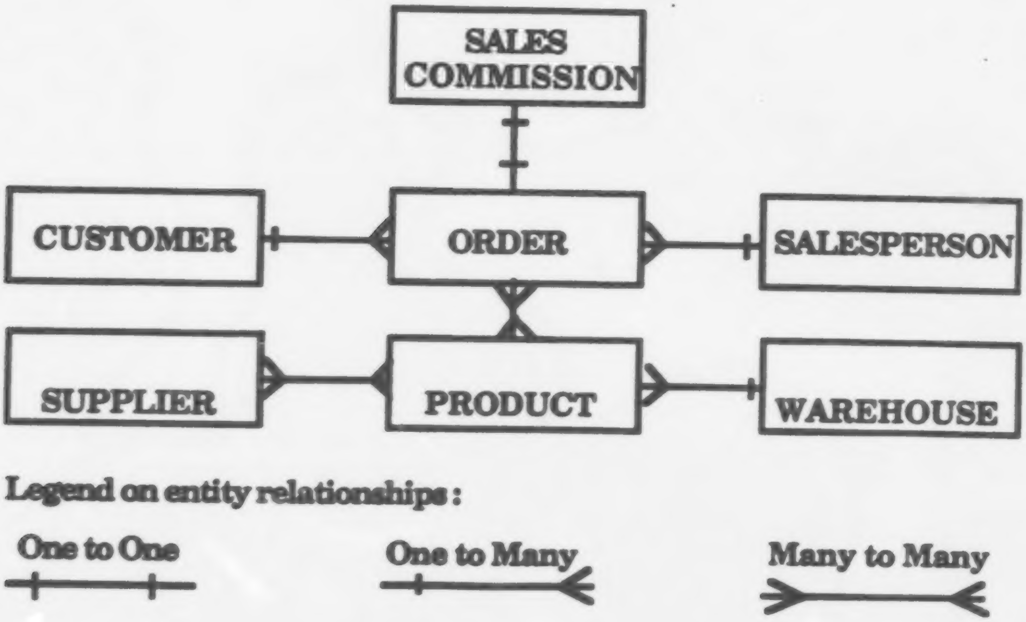

SALES COMMISSION
CUSTOMER
ORDER
SALESPERSON
SUPPLIER
PRODUCT
WAREHOUSE
Legend on entity relationships :
One to One
One to Many
Many to Many

Figure 2

Task 3 : Function Area Business Processes and Data Models

For each functional area,

a) Define business objectives and strategies

b) Define business processes. A business process is a group of logically related decisions and activities required to manage the resources of the organisation. The four stage resource life cycle (i.e. requirement, acquisition, stewardship and retirement) is used to help identify the business process.

c) Construct business process/organisational unit matrix showing organisational units which have major and minor responsibilities for each process (See Figure 3).

d) Develop data model by studying the input and output data for each business process. (See Figure 4).

e) Identify problems, if any, in executing a business process or getting or distributing data.

Task 4 : Organisation-wide Data Model and Information Architecture

a) Develop organisation-wide data model by integrating data models of functional areas, manager's information requirements and the initial data model in Task 1. (See Figure 5).

b) Consolidate and group business processes of functional areas.

c) Construct data responsibility matrix showing the data entities which are created or used by each business process. (See Figure 6).

d) Develop information architecture by rearranging the rows and columns of the data responsibility matrix. (See Figure 7). The information architecture shows the major information systems of the organisation.

Task 5 : Systems Definition and Prioritisation

a) Analyse problems identified in Task 3.

b) Describe application systems. Identify and describe the objectives and functions of application systems in each major information system in the information architecture. These application systems address the problems and support the objectives, strategies and business processes of the organisation.

c) Define application data models. Draw data model for each application system. The application model is a subset of the organisation-wide data model.

d) Prioritise application systems for implementation using criteria such as CSFs, potential benefits, impact on the organisation, complexity of system and demand for the system.

e) Evaluate current systems, i.e. to what extent do the current computerised systems meet the objectives of the identified application systems.

EXAMPLE OF PROCESS/ORGANISATION MATRIX

PROCESS / ORGANIZATION	Marketing			Sales Operations				Engineering			Production				Materials Management				Facilities Management			Administration			Finance			Human Resources			Management			
	Planning	Research	Forecasting	Territory Management	Selling	Administration	Order Servicing	Design and Development	Product Specification Maintenance	Information Control	Scheduling	Capacity Planning	Material Requirements	Operations	Purchasing	Receiving	Inventory Control	Shipping	Workflow Layout	Maintenance	Equipment Performance	General Accounting	Cost Planning	Budget Accounting	Financial Planning	Capital Acquisition	Funds Management	Personnel Planning	Recruiting/Development	Compensation	Business Planning	Organization Analysis	Review and Control	Risk Management
President	⊠	⊠	X		X		/	X				X		X		/	/	/			/	X	⊠	⊠	⊠	⊠	⊠	⊠		⊠	⊠			X
Vice President of Finance	X		X		X	/	/					X	X	/	/		X					⊠	⊠	⊠	⊠	⊠	⊠	X		X	X	X	X	⊠
Controller	X		X				/					/		/	/	/	/	/				⊠	⊠	⊠	⊠	⊠	⊠	X		X	X	X	X	⊠
Personnel Director																												⊠	⊠	⊠				
Vice President of Sales	⊠	⊠	⊠	⊠	⊠	⊠	⊠	X	X		X	X					X						X	X						/	/	/	/	/
Order Control Manager				/	/	/	/				/																							
Electronic Sales Manager				X	X	X	X	X	X		/												/	X										
Electrical Sales Manager				X	X	X	X	X	X		/												/	X										
Vice President of Engineering	X	X	/					⊠	⊠	⊠		X							⊠	⊠	⊠		X	X						/				
Vice President of Production	/	/	X					/	/	/	⊠	⊠	⊠	⊠	⊠	⊠	⊠	⊠	⊠	⊠	⊠			X										
Plant Operations Director	/	/						X	X	/	X	X	X	⊠	⊠	⊠	⊠	⊠	⊠	⊠	⊠		X	X										
Production Planning Director	X							X	X	/	⊠	⊠	X	⊠	X	X	⊠	X	⊠	X	⊠		X	X										
Facilities Manager	X											X			X	X	X	X				X	X	X				/			X			
Materials Control Manager							X		/	/	/	/	⊠	⊠	X	X	X	⊠					X	X										
Purchasing Manager			X				X			X	X	/		/	⊠	⊠	⊠	⊠			⊠		⊠	X		⊠								
Division Lawyer																										⊠	⊠				X	X		⊠
Planning Director	X				/		/	/				X		/									X		⊠	⊠	⊠	⊠			X	⊠	⊠	X

⊠ Major responsibility and decision maker

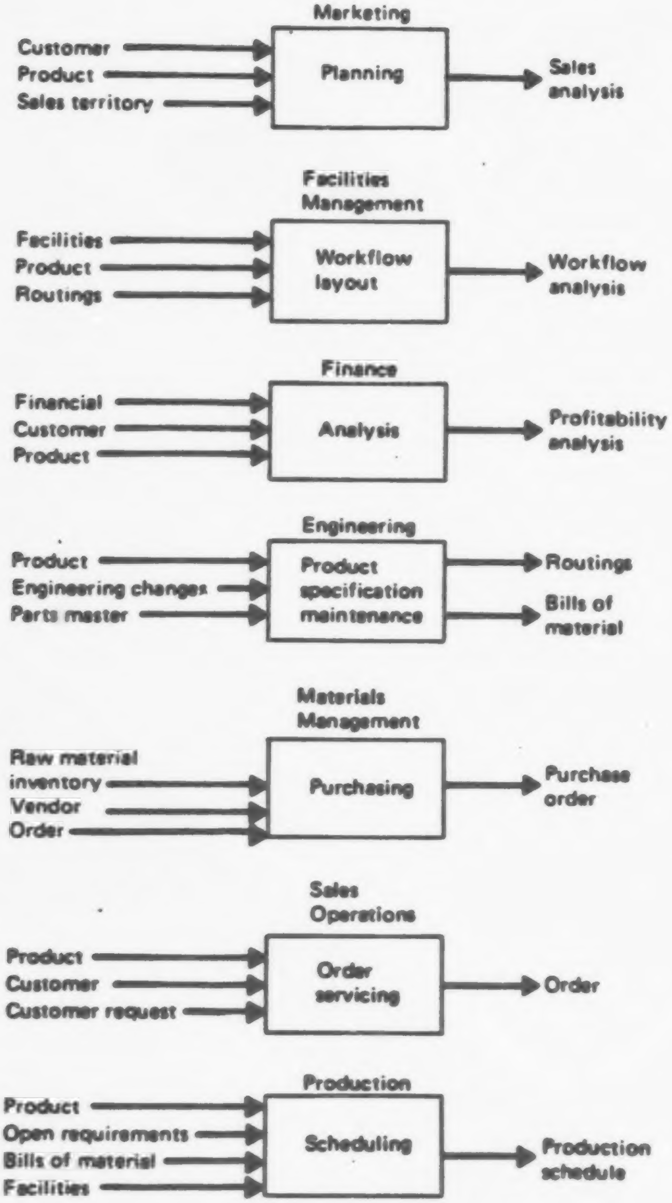
X Major involvement in the process

/ Some involvement in the process

Source: (2)

Figure 3

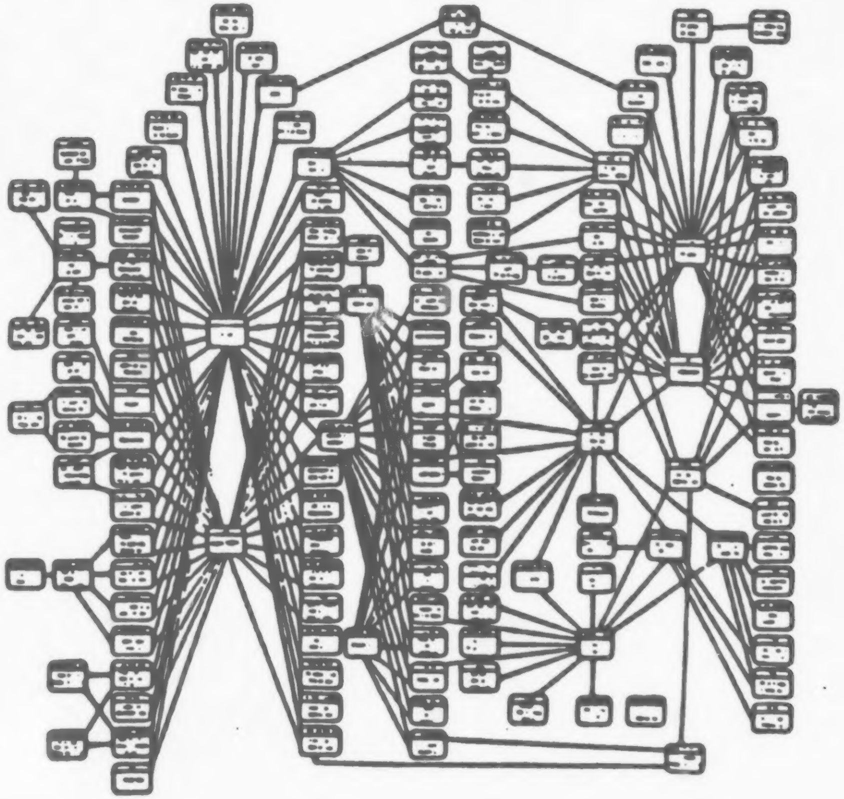
EXAMPLES OF INPUT PROCESS OUTPUT


Marketing
Customer
Product
Sales territory
Planning
Sales analysis
Facilities Management
Facilities
Product
Routings
Workflow layout
Workflow analysis
Finance
Financial
Customer
Product
Analysis
Profitability analysis
Engineering
Product
Engineering changes
Parts master
Product specification maintenance
Routings
Bills of material
Materials Management
Raw material inventory
Vendor
Order
Purchasing
Purchase order
Sales Operations
Product
Customer
Customer request
Order servicing
Order
Production
Product
Open requirements
Bills of material
Facilities
Scheduling
Production schedule

Source : (2)

Figure 4

EXAMPLE OF ORGANISATION-WIDE DATA MODEL



(The wordings in this figure are not meant to be read)

Figure 5

EXAMPLE OF PROCESS/DATA MATRIX

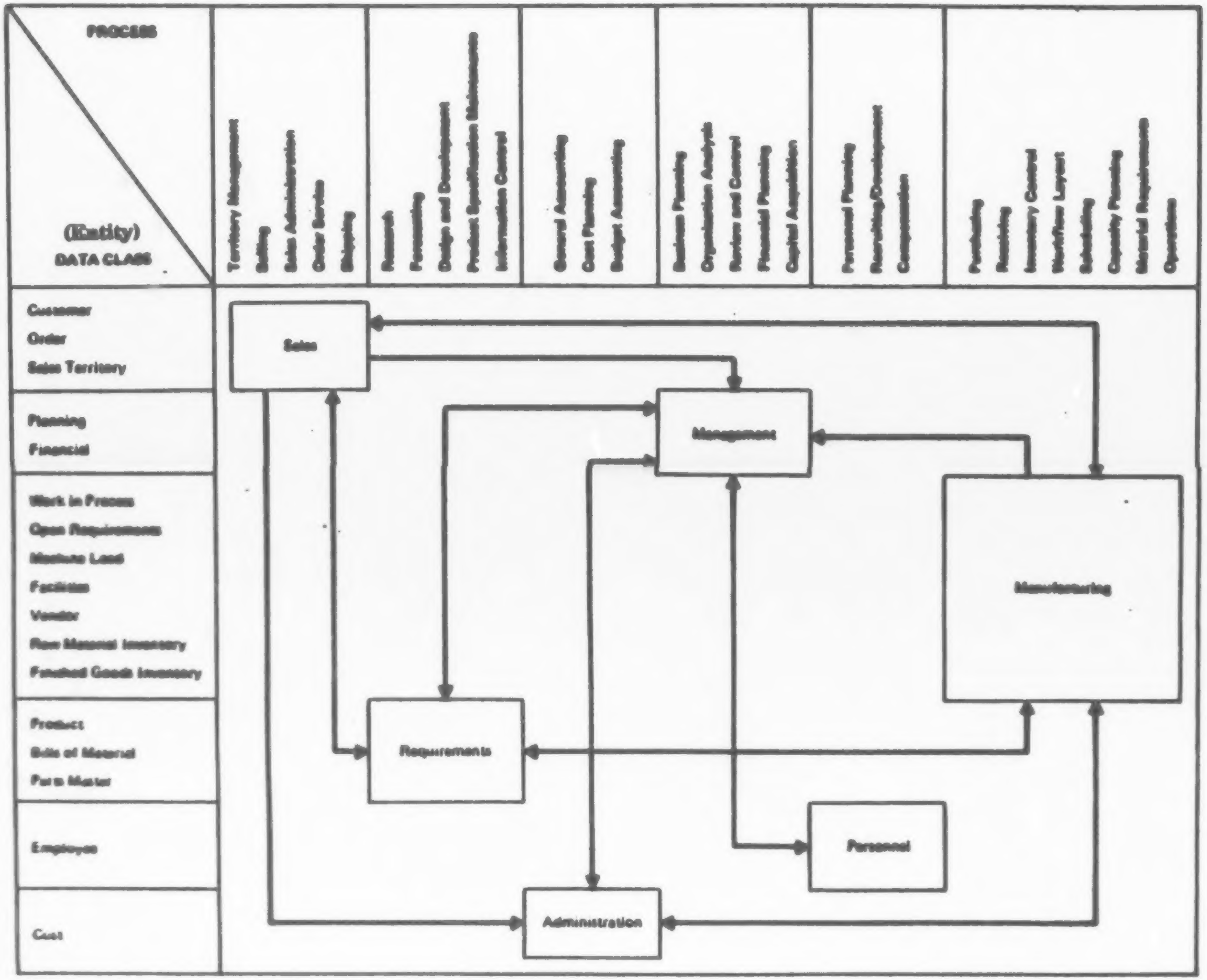
PROCESS \ DATA CLASS (Entity)	Customer	Order	Vendor	Product	Routings	Bill of material	Cost	Parts master	Raw material inventory	Fin. goods inventory	Employee	Sales territory	Financial	Planning	Work in process	Facilities	Open requirements	Machine load
Business planning							U						U	C				
Organization analysis														U				
Review and control													U	U				
Financial planning											U		U	C	U			
Capital acquisition													C					
Research				U								U						
Forecasting	U			U								U		U				
Design and development	U			C		U		C										
Product specification maintenance			U	U		C		C										
Purchasing			C				U											
Receiving			U						U									
Inventory control									C	C					U			
Workflow layout				U	U											C		
Scheduling			U	U											C	U		U
Capacity planning			U		U											U	U	C
Material requirements			U	U		U											C	
Operations					C										U		U	U
Territory management	C	U		U														
Selling	U	U		U								C						
Sales Administration		U										U						
Order servicing	U	C		U														
Shipping		U		U						U								
General accounting	U		U								U		U					
Cost planning		U	U				C											
Budget accounting							U				U		U	U	U			
Personnel planning											C		U					
Recruiting/development											U							
Compensation											U		U					

Legend : C = Create, U = Use

Source : (2)

Figure 6

EXAMPLE OF INFORMATION ARCHITECTURE


PROCESS
(Entity)
DATA CLASS
Territory Management
Selling
Sales Administration
Order Service
Shipping
Research
Forecasting
Design and Development
Product Specification Maintenance
Information Control
General Accounting
Cost Planning
Budget Accounting
Business Planning
Organization Analysis
Review and Control
Financial Planning
Capital Acquisition
Personnel Planning
Recruiting/Development
Compensation
Purchasing
Receiving
Inventory Control
Workflow Layout
Scheduling
Capacity Planning
Material Requirements
Operations
Customer
Order
Sales Territory
Planning
Financial
Work in Process
Open Requirements
Machine Load
Facilities
Vendor
Raw Material Inventory
Finished Goods Inventory
Product
Bills of Material
Parts Master
Employee
Cost
Sales
Management
Manufacturing
Requirements
Personnel
Administration

Source : (2)

Figure 7

f) Identify domain of information. Identify the entities in functional area data models and organisation-wide data model which will be computerised.

Task 6 : Cost Benefit Analysis (CBA)

a) Estimate life cycle cost of system. Life cycle cost includes the capital and recurrent costs of developing, maintaining and operating the systems - hardware, software, manpower, data conversion, data capture, site renovation, training, computer stationery, etc.

b) Identify and quantify benefits. This includes quantifiable tangible benefits like cost reduction, cost avoidance, revenue increase and non-quantifiable intangible benefits like better decision making, increased organisational effectiveness and enhanced level of service to the public.

c) Conduct financial analysis. We use the annual equivalent method based discounted cash flow techniques. The method takes into account the time value of money, interest rates, inflation and different economic life spans of capital assets.

d) Revise Task 5. The application systems and domain of automation may be modified as a result of the CBA, especially when there are systems with very low benefit compared to cost.

Task 7 : Information Resource Management and Implementation Strategy

The issues addressed include :

a) Hardware, software and network strategies.

b) Organisation, staffing and responsibility of the I/S function.

c) Data administration function.

d) Training of end-users and I/S staff.

e) Implementation alternatives e.g. contract out vs. in-house development.

f) Implementation schedule.

g) Year-by-year budget estimates.

Task 8 : ISP Report and Recommendations

a) Consolidate findings and recommendations of the previous 7 tasks into an ISP report.

ISP PROJECT STRUCTURE

A typical project structure for an ISP study is depicted in Figure 8. The project structure and staffing may vary depending on the scope of study and structure of the organisation.

Steering Committee

The steering committee is often chaired by the highest or second highest ranking civil servant in the ministry of department. It typically comprises most of the senior managers in the department

ISP PROJECT STRUCTURE

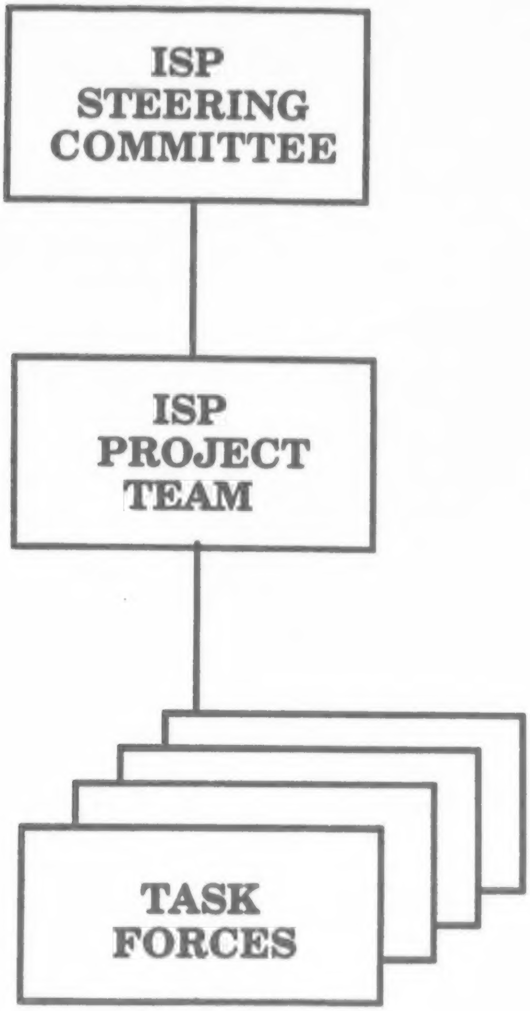

ISP STEERING COMMITTEE
ISP PROJECT TEAM
TASK FORCES

Figure 8

and a senior NCB staff. The main role of the committee is to ensure top management commitment to the study, approve the findings and recommendations of the study at major project checkpoints and resolve issues that cannot be resolved by the project team. The committee typically meets about 4 to 5 times during the study period.

Project Team

One of the senior managers in the steering committee chairs the project team. The team members include the heads of major organisational units in the department and NCB technical staff. The members from the department work part time on the project as they have to continue shouldering their normal job responsibilities. They provide most of the business knowledge of the organisation for the study. The NCB staff, who are usually assigned full time to the study, mainly provide technical advice on computerisation and the ISP methodology. The teams does Tasks 1, 2, 7 and 8 and also performs the consolidation and integration work in Tasks 4, 5 and 6.

Task Forces

Each member of the project team, except the NCB staff, heads a task force to carry out Tasks 3, 5 and 6 of the study for a given functional area. The task force consists of representatives from all organisational units connected with the functional area. Each NCB staff in the project team is assigned to one or two task forces as technical advisor.

Salient Characteristics of ISP Methodology

The following are the salient characteristics of the NCB ISP methodology :

a) It is a top down planning effort which ensures that the proposed information systems directly support the organisation's mission, objectives and strategies.

b) It provides for long term compatibility and integration of data and systems in the organisation. However, the implementation is phased to enable the benefits of computerisation to be realised early.

c) The proposed systems are flexible and able to survive organisational changes since they are based on data and business processes rather than on organisational structures. Data and business processes seldom change when the organisation is restructured.

d) It explicitly treats data as a critical organisation-wide resoure to be shared by all functional areas and levels of management in the organisation.

e) It enables top management to plan for the level of I/S spending needed in the coming years and to be aware of the tangible and intangible returns on this investment.

f) The study is jointly conducted by the organisation's staff and NCB's I/S officers. The study findings result from the synergy of the intimate business knowledge of the organisation's staff and the technical expertise of the NCB officers.

EXPERIENCE IN CONDUCTING ISP STUDIES

Institutionalise System Planning Practice

Perhaps, the greatest benefit from the ISP studies is institutionalising long range I/S planning in the government ministries and departments. We have built into the government procedures a requirement for the departments to conduct formal I/S planning before launching major computerisation initiatives. More importantly, we have also enabled the departments to carry out the planning by making available a tested ISP methodology and the related training, technical and consultancy support to them.

Through the ISP studies, the departments have come to recognise the importance and advantages of long range I/S planning. They understand why a system by system, file by file ad hoc approach to system development and planning is unsatisfactory. In a few studies, ISP actually introduced strategic thinking into the department whose only planning activities had been previously confirmed to putting up the annual budget. the ISP study made them deliberate, for the first time, on their organisation's mission, purpose, objectives and strategies.

Strategic Review Before ISP

ISP assumes that the organisation has a current strategic plan, or at elast has its mission, objectives and strategies articulated. In some of our earlier ISP studies, this was not the case. There was no well defined strategic plan or the plan was outdated. Consequently, the ISP team had to try to address strategic business issues such as defining the mission, objectives and strategies of the organisation. They found these tasks time-consuming and difficult. This is not surprising as the ISP project team members might not be senior enough to have the necessary organisation-wide business perspective to perform these tasks.

Recently, we made it mandatory for a department to conduct a strategic review before starting an ISP study. The review covers the department's mission, objectives, strategies, key result areas, performance indicators, functions to be performed, transferred out, deleted or farmed out to the private sector and streamlining of departmental functions. The review is usually conducted joingly by the department and the government's Management Services Department. The ISP study will make use of the results of the strategic review and will commence only when the review is nearly or fully completed. By tightly coupling the ISP with the strategic review, we ensure that the systems being planned address the right business problems and organisational concerns.

Management Commitment and Involvement

Our experience confirms the widely held view that strong commitment and active involvement from the department's management is a key pre-requisite for a successful ISP study. Top management mustbe seen by the departmental staff to have a keen interest in the study and its findings. They must provide the driving force to push the study forward. In addition, they must be prepared to release key managers and other staff to participate actively in the various study tasks.

Before each study, senior NCB officers typically met with the top management of the department. We discussed the main issues and concerns of managing the I/S function, presented an overview of the ISP process, highlighted the benefits of an ISP study and gave examples of completed ISP studies. We also emphasized the essential factors and important role of management for the ISP study to be successful. Thereafter, we work with the management to form the steering committee, project team and task forces for the study. The current government procedure requiring an ISP study to justify for funds for major computerisation projects also helped us in getting the departments' agreement to do ISP studies. However, virtually all departments were convinced of the value of ISP by the time the study was well in progress.

I/S Understanding of the Organisation's Business

The I/S staff found the study an enriching experience in understanding the business of the organisation. Through representation in the ISP steering committee, NCB's senior management became much more aware of the department's strategic thrusts and concerns. At the working level, the NCB officers in the study team gained valuable knowledge on the business and how the department worked. This increased understanding of the department at both the strategic and operational levels is particularly important for the NCB. It greatly facilitates NCB's role in the subsequent design, development and implementation of the systems (which are identified in the ISP) in partnership with the department.

Users' Views on ISP

Overall, the departments' management and staff reviewed the ISP effort very positively. Besides, introducing the concept of long range systems planning to them, the study also made them more aware of the key issues facing the department's I/S function. Many departments found that the ISP techniques and outputs presented them with new perspectives of viewing their organisation, such as the organisation-wide process flow charts and data models produced in the course of the study. Some staff commented that the ISP enabled them to better understand what other units in the department are doing.

Most departments felt that, on the whole, the ISP methodology was user-friendly. Nevertheless, a number of staff were initially uncomfortable in using the data modelling techniques. It was their first experience in thinking about their organisation and business in entity-relationship terms. In contrast, they were at ease with defining business processes. They can relate business processes to their daily work.

In some studies, the department's staff initially had problems differentiating terms like organisation's objectives, strategies, roles and functions. There was also a tendancy to concentrate on "what is currently done" in the organisation instead of "what should be done".

One consensus reaction was that parts of the study were too tedious. For example, many people see little relevance and value in data modelling at the detailed data attributes level.

Study Period

The time taken by some ISP studies was rather long. The recent studies took between 4 to 12 months, the average being 7 to 8 months. One major cause is that parts of the methodology are too detailed, e.g. the data modelling and CBA. Another reason is that the department's staff in the ISP team work only part time on the study. In a few studies, the duration was affected by the timing and scope of the study.

A few of our ISP studies coincided with the department's planning for major events, rush to complete other important projects with tight deadlines or seasonal peak in workload. The ISP study had to compete, often quite unsuccessfully, for the managers' scarce time. These studies progressed slowly.

Scope of Study

The complexity and therefore duration of the ISP study increases very rapidly as the scope of the study enlarges. On the other hand, too narrow a scope can result in misplaced priority in I/S implementation and long term system integration problems. This dilemma must be carefully addressed and the scope properly demarcated before the study commences. Our ISP studies usually cover one or several departments and does not cover the entire ministry.

Quantifying Costs and Benefits

Several study teams experienced some difficulty in estimating the cost of the systems, especially on hardware and software development. The main reason was that the system specifications in the ISP were not sufficiently detailed enough for estimating the costs accurately.

Identifying and quantifying the benefits of systems implementation was not easy in the CBA of a number of ISP studies. Some important system benefits were intangible and not quantifiable, such as better decision support and more effective communication. This was particularly so for strategic information systems. Some of these systems were critical to the department but have negative CBA because only the quantifiable benefits were counted.

Planning for Non-Conventional Systems

The ISP methodology has proved to be effective in planning for conventional information systems and data bases. However, some of the departments studied required text processing, office automation, computer-aided design and drafting and expert systems. The present ISP methodology is not so suitable in addressing these types of systems.

Computer-Aided ISP

Most of our studies used the POSE (8) product running on PCs to draw data models and manage data dictionaries. It reduced the effort needed to integrated or revise data models and dictionaries considerably.

The manual manipulation of the rows and columns of the process-data matrices leading to finalisation of the information architecture in Task 4 is rather cumbersome. At present, we do not have any automated tools to assist in this task.

CONCLUSION

The NCB ISP methodology has been applied successfully in long range information systems planning in the Singapore Civil Service. In the process, we have introduced and sustained the practice of long range information systems planning in government departments. The NCB will continue to enhance its ISP methodology based on the feedbacks from the ISP practitioners and to keep pace with the rapid advances in information technology.

ACKNOWLEDGEMENTS

The author would like to thank many colleagues for sharing their ISP experiences with him during the preparation of this paper.

DISCLAIMER

The opinions expressed in this paper are those of the author's and do not necessarily reflect those of the National Computer Board of Singapore or any Singapore government department or agency.

FOOTNOTES AND REFERENCES

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6. Christine V. Bullen, John F. Rockart, "A Primer on Critical Success Factors", Centre for Information Systems Research, Sloan School of Management, MIT, MA, USA, 1981.

7. For example, see Richard Brealey and Ste[illegible]d Myers, "Principles of Corporate Finance", McGraw Hill, 1984, Chapters 2, 3 and 6.

8. "Picture Oriented Software Environment" (POSE). POSE is a workstation-based software development tool developed by the NCB and marketed internationally by the Computer Systems Advisors Group of Singapore.

PRACTICAL USE OF THE DAFNE (1) METHODOLOGY

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Vice President, Italsiel
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LINDA CRIMERSMOIS
Manager, Methodology Department, Italsiel
Rome, Italy

Paper presented by Mr. Alfredo Pelella, Application Manager of Public Administration, Italsiel. Mr. Sigillo and Mrs. Crimersmois were unable to attend.

1. INTRODUCTION

Established by IRI in 1969, Italsiel has rapidly expanded to become the leading Italian software house. The company today employs 1500 people, 80% of which are University graduates.

Italsiel's main activities are the development, operation and maintenance of large management information systems.

The complexity of these tasks has led Italsiel to start, at the end of the last decade, an applied research program in software engineering, aimed at:

- providing a framework to formalize the corporate know-how by transferring individual capabilities into a well-defined process
- establishing a permanent structure and procedures to manage the framework evolution requests coming from changes in the requirements and from advances in software engineering.

The main emphasis of the research was on the definition of the development process of large and complex systems, with a life span of 5 to 10 years, which implies the cooperation, communication and coordination of a large number of different specialized groups for a considerable period of time.

This domain of research has often been characterized as Programming-in-the Large (the composition of modules into systems) and Programming-in-the many (management multiple programmers).

The research was structured in three main steps:

- definition and rationalization of the software production process
- standardization and optimization of intermediate and final products of the process
- progressive automation of the process and related products.

---

(1) DAFNE is a registered trademark by Italsiel S.p.A.-C.N.R.

Parts of this program have been carried out in cooperation with the industrial and academic world in joint projects sponsored by CNR (Italian National Research Council) and CEC (ESPRIT).

A first important result of this program was attained in 1982 with the first version of the Analysis and Design methodology DAFNE (Data and Functions NEtworking). This paper describes the architecture of DAFNE and discusses the results achieved.

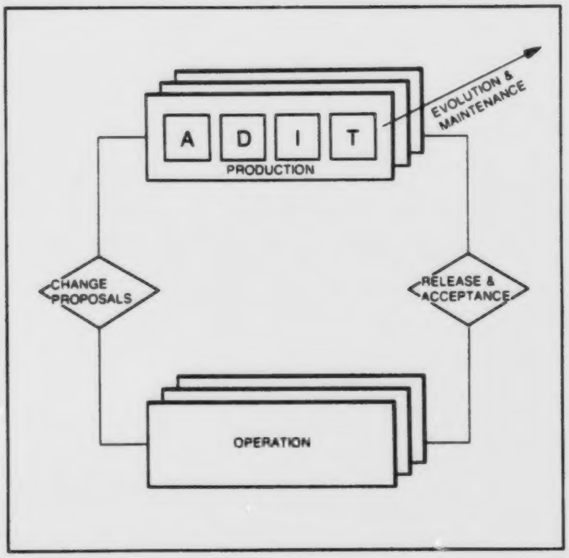
2. THE DAFNE METHODOLOGY

2.1. DAFNE Requirements

The production techniques used to minimize the probability of maintenance interventions are destined to be successful only in part if due attention is not accorded to the optimization of the maintenance environment and the ways maintenance is performed.

Hence Italsiel decided to adopt a software life cycle model which stresses the orthogonality of the maintenance activity to the development activity (see fig. A).

Figure A: ITALSIEL Software life cycle



This model shows that the software development process is an ordered sequence of cycles each of which produces a different version of the software pr product. Each iteration is triggered by a specific decision and originates a specific development project.

The adoption of this type of software life cycle model has a substantial impact on the definition of an analysis and design methodology, together with the usual objectives that a methodology must achieve, such as:

- understandability of the documentation

- system complexity handling

- production progress control

- quality assurance

The need for software that is "portable" - and therefore understandable by different people - implies:

- special attention to the problem that could be caused by the introduction of a methodology into environments with existing standards and different working methods;

- selection of formalized and structured documentation languages.

The need to guarantee exact and rapid interventions on existent software (understood not only as programs code but also as documentation at all levels) leads to:

- the definition of a software architecture with a high localization level;

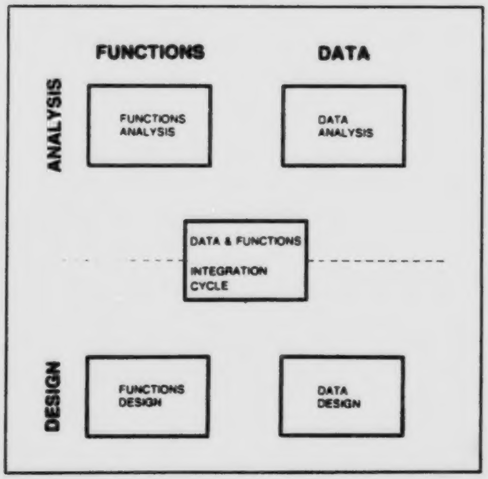
- structured documentation, developed during the production process.

2.2. DAFNE Architecture

2.2.1 A modular approach

DAFNE is a framework that splits the software production process in to independently performed activities, linked by definite interfaces (fig . B)

Figure B: Modular lay-out of the methodology


FUNCTIONS
DATA
ANALYSIS
FUNCTIONS ANALYSIS
DATA ANALYSIS
DATA & FUNCTIONS INTEGRATION CYCLE
DESIGN
FUNCTIONS DESIGN
DATA DESIGN

This approach makes it possible to solve:

- problems of introduction into different environments

- problems in the use of a methodology for projects at different stages of development

The activities

The activities are separated in two directions:

- vertical (between analysis and design) to obtain:

    . documentation of the options;
    . guarantee that the design options do not 'pollute' the analysis results;
    . gradual introduction of realization constraints in the transition from analysis (the What') to design (the 'How');

- horizontal (between data and functions) to obtain:

    . an accurate examination of the 'semantic' aspect of the data;
    . the analysis of a system from different viewpoints as a guarantee on the completeness of analysis;
    . assurance for adequate relevance to data during the analysis phase and the design phase as well.

The interfaces

The separation of activities allows the setting of some check points during the process in order to:

- check analysis completeness (functions-data interface);

- handle the analysis-design transition;

Use strategies

The various modules that make up the methodology can be introduced separately according to the requirements of the working environment and the characteristics of the individual projects. The main use configurations of the methodology can be defined as follows:

- complete use of the methodology for new project;

- partial use on projects under development where functions analysis has already been completed: documentation of the results obtained and integration with the data analysis and design modules;

- bottom-up use of the data analysis techniques on operational projects: this provides an overview of the existing software system in terms of entities and relationships identified through a procedure of file-stored data abstraction.

This approach helps to understand:

- the reality represented by the existing software system

- the decision and realization constraints that led to the present system.

2.2.2 'Portability' of the documentation: use of formalized representation techniques

The language used to represent the analysis and design activity products is the determining factor for communication during the projects and systems life.

The use of formal languages that transform a series of information expressed in natural language into a clear and synthetic representation provides a visibility that is an essential instrument for the control of production process.

This visibility enables the production staff to measure the level of quantitative and qualitative progress and the users to verify the correspondence between the requirements expressed and the solutions proposed.
The results are an increased awareness of the problem and a better readability of the products.

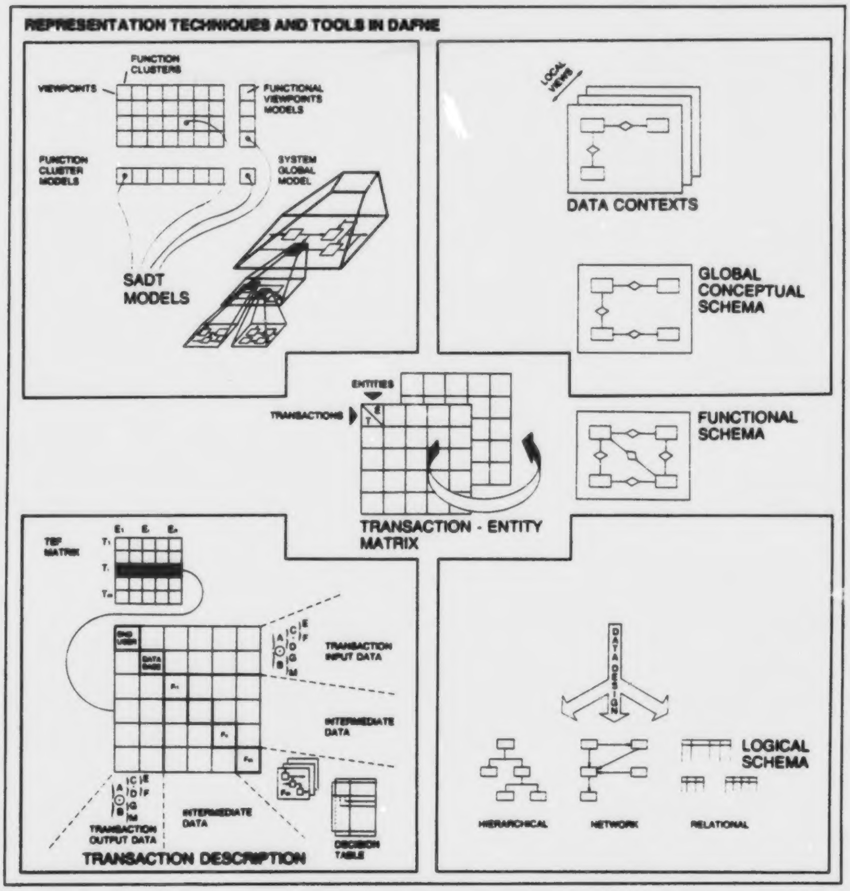
The graphics representation techniques integrated in DAFNE are:

- SADT for functions analysis;
- ERA (Entity Relationship Approach) for data analysis;
- matrices for the data-functions networking;
- N2 charts, Warnier notations, and decision tables for functions design;
- the representation languages of the different DBMSs, for the data design.

These techniques have been adopted and boosted in order to facilitate their use or improve their information content.

The requirement imposed on the choice of the representation formalisms guarantees a clear separation of the activities (analysis-design, functions-data) through the separation of languages.

Figure C: Representation techniques in DAFNE


REPRESENTATION TECHNIQUES AND TOOLS IN DAFNE
FUNCTION CLUSTERS
VIEWPOINTS
FUNCTIONAL VIEWPOINTS MODELS
FUNCTION CLUSTER MODELS
SYSTEM GLOBAL MODEL
SADT MODELS
LOCAL VIEWS
DATA CONTEXTS
GLOBAL CONCEPTUAL SCHEMA
ENTITIES
TRANSACTIONS
E
T
FUNCTIONAL SCHEMA
TRANSACTION - ENTITY MATRIX
E1 E E
TEF MATRIX
T1
T
Tm
END USER
DATA BASE
A B C D E F G M
TRANSACTION INPUT DATA
INTERMEDIATE DATA
TRANSACTION OUTPUT DATA
INTERMEDIATE DATA
DECISION TABLE
TRANSACTION DESCRIPTION
DATA DESIGN
LOGICAL SCHEMA
HIERARCHICAL
NETWORK
RELATIONAL

2.2.3 Localizing Maintenance Interventions: structured documentation

The software product design process can be compared to a decision-making process which transforms a group of non-formalized potential solutions into an unique and specific solution that responds to the user's functional and non-functional requirements with full respect for technical implementation constraints.

The need for product traceability

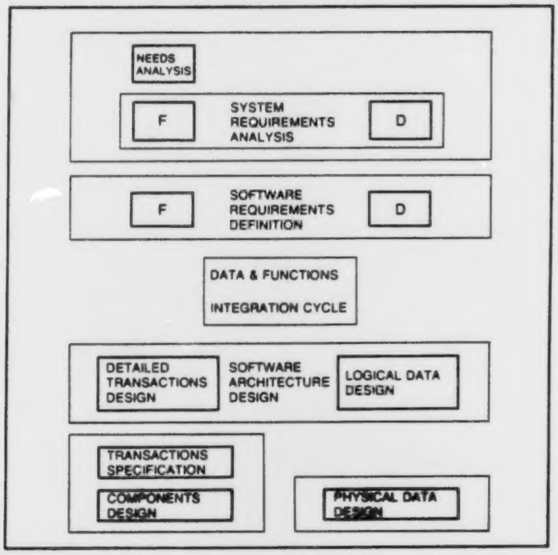
This decision-making process must be documented in such a way that the products of each step be clearly traceable to the corresponding products of preceding and successive steps. Traceability is required:

- during the production phase when an error from an earlier phase is to be corrected and the consequences assessed;
- during the maintenance phase to assess the direct and indirect consequences of a modification, and to distinguish the technical implementation options from the constraints defined by the user.

Figure D illustrates the complete lay-out of the methodology and highlights the splitting of the process into steps.

Each step has a well-defined scope and a product which documents the decisions related to that step.

Figure D: Methodology lay-out


NEEDS ANALYSIS
F
SYSTEM REQUIREMENTS ANALYSIS
D
F
SOFTWARE REQUIREMENTS DEFINITION
D
DATA & FUNCTIONS INTEGRATION CYCLE
DETAILED TRANSACTIONS DESIGN
SOFTWARE ARCHITECTURE DESIGN
LOGICAL DATA DESIGN
TRANSACTIONS SPECIFICATION
COMPONENTS DESIGN
PHYSICAL DATA DESIGN

2.2.4 Maintenance Intervention Localizing: Software Architecture

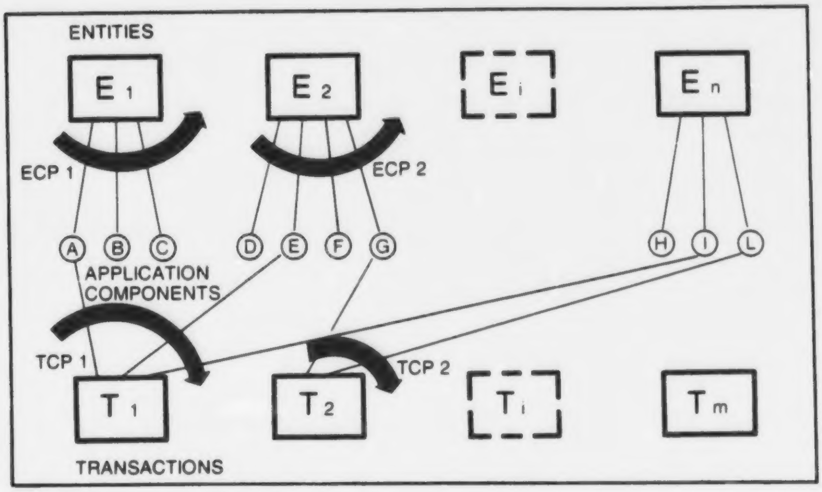
An application system consists of three different types of objects:

- the system data (entities and their relationships);
- the elementary functions that create, update, read, etc. those data (functions);
- the processes that link the elementary functions to satisfy the end-user's requirements (transactions).

This overview suggests that the architecture be established on numerous levels, each pertaining to one of the objects listed above.

In DAFNE, therefore, three different types of software objects are to be realized (fig. E).

Fig. E: Software Architecture



They are:

- application components which include one or more functions operating on a single entity
- transactions control path (TCP) components, which activate for each transaction the correct sequencing of application components
- entity control path (ECP) components, which determine for each entity whether application components scheduled by different TCP maybe executed; this determination is effected by checking the status of the entity occurrence to be treated.

An architecture conceived in this way provides for the identification of the software objects that call for maintenance intervention and limits the consequences of the intervention. For example, the modification of a system entity has an effect only on its ECP and the application components that handle that entity. Moreover, the request for a new transaction that does not change the system's elementary functions only effects the TCP's level.

2.3 DAFNE AUTOMATION

The automation of DAFNE is an important contribution for an easy and effective use of the methodology. The Italsiel target is to develop a flexible and integrated environment that could support all the activities of the analysis and design phases.

Two convergent approaches have been followed, applied to Italsiel software life cycle methodology context:

- top-down
- bottom-up.

In the top-down approach the automation of the software life cycle started from the high level activities.

A nucleus of the environment has been developed: it includes tools to support the graphical techniques embedded in DAFNE (SADT, ERA, N2). The environment is based on a project dictionary that manages all relevant objects and assumes the consistency of the information.
Tools were developed on a personal computer workstation to support the representations techniques embedded in DAFNE (SADT, ERA, N2) based around a central project dictionary.

In the bottom-up approach a step-by-step automation process has been applied to the lowest phases of SLC, i.e. implementation and test.

Mainframe-based tools were developed, each covering a specific activity.

The final result of this convergent approach will be a Computer Integrated Manufacturing System.

3. THE USE OF DAFNE

The architecture of the DAFNE methodology has been designed to guarantee the possibility of adjustment to different environments. This capability is a key factor in keeping up with the evolution of the scenario of software engineering and in broadening the spectrum of its applicability to different software development paradigms and software product types.

The flexibility of DAFNE has been shown by its use in very different contexts:

- development of large information systems;
- support to advanced research projects.

3.1 Use of DAFNE for the development of large information systems

DAFNE was originally designed to face the specific needs and problems arising in planning, designing and implementing a system for the Italian Ministry of Treasury to handle the state budget.

Since then DAFNE has been used in the majority of Italsiel's projects concerned with the development of information system for the Italian Public Administration (Ministry of Health, Ministry of Public Education, ...) as well as in several large projects for industries and banks.

An indication of the widespread use of the methodology in this area is given by the size of the projects developed with DAFNE by Italsiel over the 83-85 period : 520 man-years.

3.2 Use of DAFNE in research projects

DAFNE has been used to support research projects sponsored by the EEC (ESPRIT Program and EUREKA) related to the following areas:

- Information Technology

- Computer Integrated Manufacturing (C.I.M.)

- Office systems

As an example, the use of DAFNE in two Esprit projects will be outlined.

These two projects were a significant test of the applicability of DAFNE to the modelling of office systems and of Computer Integrated Manufacturing systems.
ASTRA is an Esprit project carried out by an European consortium in which SOGEI, another FINSIEL Group company, is the prime contractor.

The objective of the project was to analyze the requirements of Public Administration office systems and to implement and assemble components of integrated office system prototypes based on such requirements.

In the context of this project the analysis techniques integrated in the DAFNE methodology were used by all the partners as a common language for:

- modelling office functions within departments of the Public Administration of the countries represented in the Consortium

- integrating the results of user needs analysis carried out by each partner.

The objective of the other project was to identify opportunities of computer integrated manufacturing for heavy welded fabrication.

In this context DAFNE has been chosen by the European partners of the consortium as a methodology of project management.

DAFNE was used for the following activities:

- analysis of different welding manufacturing systems

- derivation of a generalized reference model for the factory of the future for this type of industry

- instantiation of the reference model for specific applications

- analysis of the tools available on the market and mapping between their functions and the requirements specified in the reference model.

4. RESULTS OBTAINED FROM THE USE OF DAFNE METHODOLOGY

The scope of this section is to highlight the results obtained by Italsiel from the use of DAFNE methodology in pilot projects. The impact on quality of the product and productivity of the process were collected to understand.
The observation is relative to a period of 4 years which includes the entire development phase and the first year of maintenance.

4.1 Characteristics of pilot projects

The four projects were part of a larger effort to automate procedures within the Ministry of Treasury.

Their target was to develop information systems for the following areas :

- state accounting (1)

- personnel management (2)

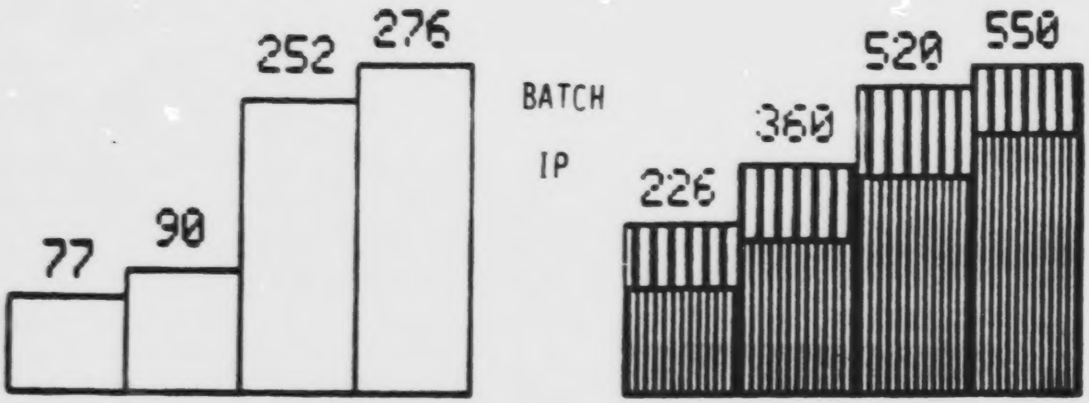
- state budget (3)

- control of expenditures (4)

These systems were developed in an IBM MVS/CICS/DL/1 environment.

Figures F outlines the dimensions of the projects in terms of number of TP transactions and number of lines of code (LOC).

Fig. F: Characteristics of pilot projects



(1) (2) (3) (4) Projects (1) (2) (3) (4)
Number of TP transaction Number of LOC X 1000

4.2. Effects on the development phase

The methodology was developed and introduced in Italsiel to reach three main objectives:
- reduction of the cost of the process
- reduction of the complexity of the process
- reduction of the complexity of the product.

4.2.1. Effects on the costs of the process

The effect of the methodology's application on the production process was a substantial variation in the relative relevance of the various development steps.

Fig. G: distribution of time and costs on analysis, design, implementation and testing

TIME

	BEFORE	NOW
A	30	40
D	10	18
R & T	60	42
	100	100

COSTS

	BEFORE	NOW
A	20	30
D	15	20
R & T	65	50
	100	100

The increase in costs of analysis activities, due to the use of structured techniques, is balanced by the decrease in costs of the coding and test phase due to factors such as:

- completeness of the specifications due to the quality control tools embedded in the analysis and design techniques used in the methodology;
- high level of software components reuse due to the software architecture;
- reduction in compilation time due both to the reduced dimensions of the components (reduction in the time of one compilation) and to the low complexity of the components (reduction in the number of compilations of a single component);
- understandability of the software (the ratio between the pages of documentation and the lines of code in 1:82).

4.2.2 Effects on the complexity of the process

The most significant advantages demonstrated by the experiment is the guidance of the process.

The guidance of the process implies on one hand the visibility of the process for the developer and on the other hand the control of the process for the customer/user.

The visibility of the process is guaranteed by a step-by-step approach.
As an example DAFNE methodology splits the requirements phase, traditionally the most informal

one, into three steps:

- user requirements
- system requirements
- software requirements

Each of these steps produces well defined products with specific scope, context and point of view which are models of the real world in terms of functions (function models) and of data (data models). The transition from a product of one step to the product of the following step is regulated by specific criteria.

4.2.3 Effects on the complexity of the product

The software architecture implied by the use of DAFNE methodology is based on the following concepts:

- modularity
- localization
- code reuse

The data presented in this paragraph compare the measures of these software characteristics in two types of projects:

- the four pilot projects developed with DAFNE

- previous Italsiel projects that used only structured programming techniques (Warnier).

Warnier is still used as the basic technique in the programming phase but it is now a component of an integrated set of structured techniques that covers the entire SLC.

Figure H shows the overage size of the components developed by the two sets of projects. For the pilot projects the average size is given for each specialized component that is created by the DAFNE software architecture:

- external application components
- transaction control path
- entity control path.

Each type of component has its own internal structure in terms of functional modules.

The relatively large size of the transaction control path is due to specific implementation constraints: they often include application components.

Figure I evaluates the level of reuse of the components an a function of their type and compares the total size of the system (obtained by expanding reused components) and the lines of code actually developed.

Fig. H: Modularity - Components size in LOC

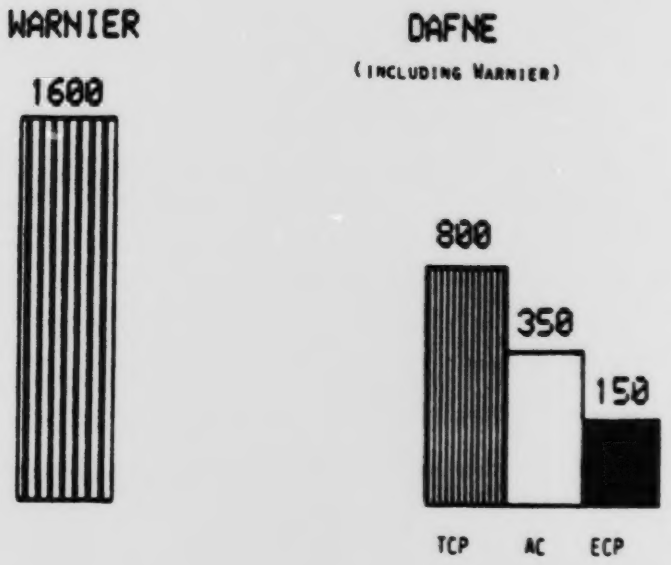
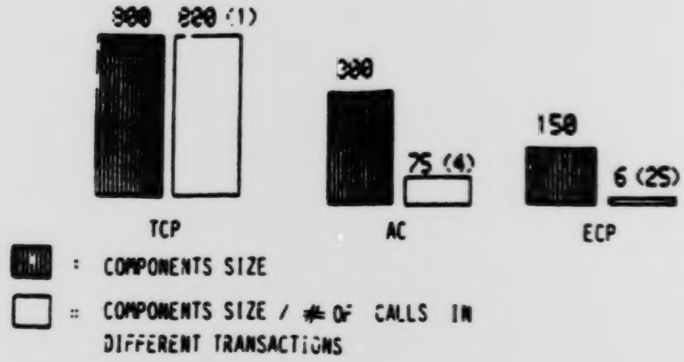


Fig. I: Code reuse



4.3 Effects on the maintenance phase

DAFNE is a methodology for the development and maintenance of information systems.

Requirements for the methodology for the maintenance phase were:

- reduction of the cost of corrective maintenance
- reduction of the complexity of the evolution maintenance process

4.3.1 Effects on costs of corrective maintenance

The effects of the methodology's application on the development process were:

- a substantial reduction (from 7% to 4%) of the number or errors related to the analysis and design activities identified during the first year of production compared with the number of coding errors

- an easier error detection and error isolation due to the high modularity and localization of the software architecture.

The results obtained, related to corrective maintenance, during the first year of production were:

- a reduction of 40% of the global cost evaluated in terms of resources needed for corrective maintenance of one line of code

- a reduction of 20% of the time of correction

4.3.2 Effects on complexity of evolution maintenance process and on the control of the product

Maintenance is a quality of the software product obtained by the use of a structured methodology in the development phase. This quality can rapidly decay if maintenance is not performed with the same structured approach, in the pilot projects, the use of DAFNE completely changed the approach to evolution maintenance.

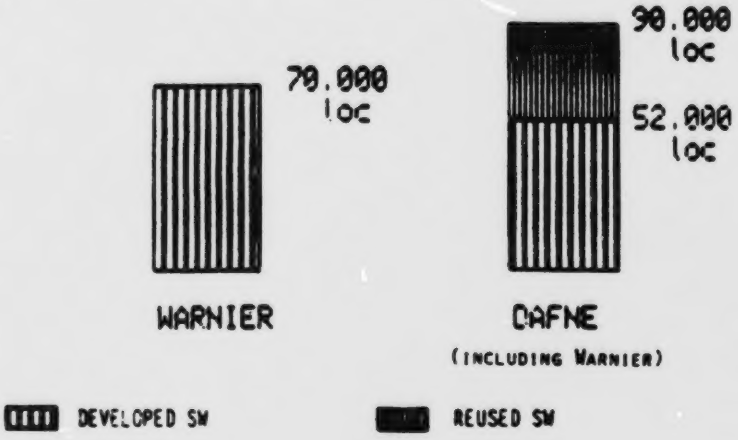
The traceability of the process and of the information contained in the products of the process enabled the implementation of a project dictionary to keep under control the software organization. Such a dictionary documents the relation ships between the various entities that constitute the software system (software components, transactions, functions, entities of the data conceptual data model, entities of the logical data model,...). It is mainly populated with information directly derived from the production environment (libraries, data dictionary, ...) and therefore consistent with the actual state of the software product.

In relation with the origin of the maintenance request (implementer, user, responsible for production or maintenance) it is possible to have access to the dictionary from different points of view to identify all the entities involved in the maintenance request and the propagation effect on other correlated parts of the system.

Fig. L shows the consequences of this approach to maintenance.

The product not only evolves through the development of new code (with the consequent rapid loss of the knowledge of the product structure), but also through the reuse of existing components.

**Fig. J : Evolution of a structural sytem
Developement of 50 new TP transactions**



5th Plenary Session
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GUIDELINES FOR GOVERNMENT POLICIES

USE OF METHODOLOGIES FOR PLANNING AND DESIGN OF INFORMATION SYSTEMS IN PUBLIC ADMINISTRATION. SOME LATIN AMERICAN EXPERIENCES

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INTRODUCTION

This paper reviews the use of formal methodologies in planning and designing information systems in Public Administration, with particular reference to the experience acquired in this respect by a selected group of Latin American countries. The review of this experience will lead to conclusions and recommendations which will eventually result in a more effective use of said methodologies.

There is abundant international experience in the use of methodologies for planning and designing information systems in government offices, ranging from brochures containing simple recommendations regarding the components of a system to comprehensive methodologies encompassing the whole process of planning, design, implementation and assessment, and contained in voluminous manuals. Despite this experience, there is practically no systematic research, nor reliable data indicating the impact and results of the application of all this material, particularly as far as Latin America is concerned.

This paper is based essentially on the analysis of the documents used in the planning and designing of information systems in selected countries of the region, general and specific reports relating to the subject, complemented by interviews with high-level executives of information systems at national or sectorial level. The results presented are derived from the review of the aforementioned material from the point of view of the impact of the methodology in the substantive and organizational area, rather than the intrinsic technical characteristics of the information system in itself.

The critical importance of information and its adequate treatment for the effective and efficient functioning of government services has been stressed repeatedly. Emphasis has also been placed on the extraordinary complexity of the task of planning and designing said systems for the public sector. Furthermore, it has been pointed out that up to now, the effectiveness of computers in public organizations has been limited, due to several problems including data quality and accessibility, the evolution of the system itself, interface difficulties and, at a different level, organizational and political problems. (Tien and McClure, 1986; McDonald, 1986a).

As regards the two latter aspects, public sector specialists in information systems have drawn attention to the particular characteristics of public organizations, which call for a different technical procedure in the installation of information systems from that traditionally employed in private enterprise. (See Bozeman and Bretschneider, 1986). These differences appear to provide the basis for a different approach which is now being explored. (1)

To this are to be added other complexities in the development of information systems in the case of the Latin American countries, the most outstanding source of which is perhaps the number of functions assigned by the socio-political systems to the public apparatus as a result of the population's constantly growing demand for basic social services and the production of goods. The scope of these functions transcends that of the traditional functions of the public sector in the developed countries, which fact is reflected in a large number of public entities operating in the central, regional or local sector, in addition to an important sector of State enterprises. A third characteristic is the magnitude of the labour force employed in the Government as officials, a great many of whom are professionals and technicians, or blue collar workers. (Between 20% and 40% of the professionals in the countries work in the public sector). The public apparatus has also been entrusted with the task of orienting and stimulating economic development and in many cases assuming the direct responsibility of it, and those tasks are still being performed by the public sector, a fact which is strongly criticized by the neoliberals.

The degree to which the mentioned characteristics are to be found in the Latin American public sector differs greatly from one country to another, but they all share the common characteristic of presenting serious organizational and functional problems which limit their efficacy and effectiveness in performing the tasks entrusted to them. This situation, in recent years, has given rise to multiple efforts towards change and modernization through administrative reforms or processes of improvement and modernization. It can be said that the public apparatus of the Latin American countries has undergone constant revision and changes, but owing to their purely formal nature, said changes have not had a possitive effect on their functioning or performance (Kliksberg, 1984).

This process of growth and change in government services has been accompanied by a pronounced growth in the number of computers and their accessories installed in government offices, stimulated by the real needs of the entities and by an aggressive sales policy on the part of the major world producers (2). The situation is further complicated by the explosive technological development in the field of informatics. Thanks to microcircuits, electronic chips and large scale miniaturisation and integration, mini and microcomputers have taken the place of the gigantic mainframes whereby, at the end of the fifties and sixties, information was centralized in large dataprocessing units for the purposes of records and transactions involved in tax collection, payment and processing of government staff payrolls, pensioners' records or inventory control, etc. With this new equipment, located in small local units, the computation capacity can be redistributed and decentralized. Moreover, equally significant changes in communications give the opportunity to operate in networks and provide remote access to the large data bases established in the major computer centres.

This whole complex situation constitutes a great challenge today. In view of the growth of government services and the changes occurring therein, together with the technological revolution, we have few sound operational bases and it is difficult to know whether there exists an optimal manner of introducing the development of informatics into the public sector, in such fashion as to facilitate the changes which are taking place therein. We definitely do not have the answer to that question yet and it may be that, generally speaking, there is no one single answer. Only by reflecting on the most successful experiences and carrying out systematic research in this field we will be able to determine with greater certainty the basis on which we should operate.

That is the approach taken in this paper. Now more than ever in Latin America, when the people's demands for education, work, housing and general well-being are strongly felt and with the present shortage of funds to satisfy those demands, we are faced with the challenge of adapting the information systems and using them as efficiently and productively as possible for the government organization, and an important factor in the response to that challenge lies in the improvement of the planning and design of said systems. Hence the importance of making the most adequate use of the best methodologies. Their role can only be ascertained in the light of their application in the context of the Public Sector, its policies and programmes and the institutional arrangements made to this end.

1. INSTITUTIONAL ARRANGEMENTS IN LATIN AMERICA

All the Latin American countries to which this paper refers have developed, in the course of the past twenty years, a centralized institutional system to direct and control the development of information systems in the public sector.

As of the mid-sixties, serious concern was aroused in government services with regard to the purchases of large items of computer equipment, much of which was only partially used, and which involved substantial public expenditure. The task of controlling those purchases gave rise to a whole process of institutionalization of the direction and monitoring of the development of information systems in the Latin American Government Services. In Argentina, in 1968, this task was entrusted to the General Secretariat of the Presidency and the System of Data-Processing of the Public Sector was created. In Brazil the Commission for the Co-ordination of Data-Processing Activities (CAPRE) was created, chaired by a representative of the Ministry of Planning and Co-ordination. In Ecuador, in 1978, the National Informatics Commission was set up, comprising representatives of General Administration bodies. In Mexico, in 1973, the function was institutionalized in the General Division of Administrative Studies, and the Technical Advisory Committee on Data-Processing Units of the Federal Public Sector was created. This Committee considers and approves State purchases of computer equipment. Finally, in Venezuela, at the beginning of the seventies, that same task was assigned to the Central Office of Statistics and Information through the Central Office of Informatics.

In most cases, some time elapsed, during which the control systems operated, before taking the important step of attempting to formulate a public policy for the development of informatics in the respective country. To this end, the procedure usually consisted in extending the scope of the functions of the existing organisations and giving them increased representativity, or in creating new and more powerful organisations to perform these functions. In Argentina, the Office of the Under-Secretary for Informatics (Subsecretari'a de Informa'tica) was created in 1978 within the Ministry of Planning, its function being to formulate and implement the policies in the sector and to control the information systems of the public sector (3). Recently, with the new democratic government and following a trend witnessed in other countries, the central unit is connected not with planning but with Science and Technology, thus opening up new areas of interest in the field of informatics. At the same time an Informatics Commission was created, comprising the Ministers or Under-Secretaries of the most important Ministries. This Commission was entrusted with the preparation of a National Plan of Informatics and Associated Technologies. Up to date, this Commission has laid the bases for an informatics policy. Brazil, on its part, towards the end of the past decade, created the Special Ministry of Informatics, attached at that time to the National Security Council. The old CAPRE, expanded to include representatives of the Science and Technology and Industrial sectors and of the private sector, became the Informatics Commission. This institution centralizes and handles, quite autonomously, all the informatics policy in Brazil as well as handling and controlling everything relating to informatics in the Federal Administration, but not in the local Administration or that of the Federate States. Its policies are the broadest and most comprehensive of Latin America but its control over the government information system is in no way co plete. Ecuador is the only country, due perhaps to the delay in its incorporation, which, from the very beginning, proposed the creation of its first control unit, the National Informatics Commission, which was also entrusted with the task of formulating the corresponding policies. Subsequently, the Technical Secretariat of Informatics was established, which is directly attached to the Presidency of the Republic (4). In the case of Mexico, towards the end of the past decade all the functions related to informatics in the country, and particularly in the public sector, were assigned to the Ministry of Programming and Budgetary Affairs, through its General Division of Informatics Policy, which has accomplished an important task particularly in the field of information systems in the public sector. Its normative competence is limited to the National Federal Administration, but it has made a great effort to encourage, promote and co-ordinate actions with the governments of the Federate States and local governments (5).

In Venezuela, in 1984, the OCEI created a National Informatics Commission, responsible for the establishment of policy guidelines in the public sector. This Commission mainly comprises representatives of the Central Bank, the Ministries of Defense and Finance and the National Telephone Company (6).

All these organizations in each one of the aforementioned countries have succeeded in forming groups of highly qualified technicians and professionals, who have endeavoured to achieve the goals or objectives of their institutions. However, with the exception of Brazil which, owing to the ambitiousness of its national project for the development of informatics and its enormous public apparatus, has a relatively large professional corps, the rest of the countries have only managed to maintain small groups of officials in charge of these matters.

As can be seen, the organizations in charge of informatics and particularly of the information systems in government services, have gradually become more complex, raised their political and hierarchic-bureaucratic status, expanded their councils or committees to include representatives of sectors or interests closely connected with informatics as an industry and as an organizational resource; they have been endowed with authority to direct the area, have formed their groups of qualified professionals, albeit limited in number. However, in these organizations, which are legally authorized to formulate policies and to design and control the development of informatics in the country, and particularly in the public sector, owing to the limited resources available, in practice are only partially successful in exercising their authority over a vast field of organizations, the actual result being a non-planned decentralization.

It is important to note that as far as the direction and control of the information systems in the public sector is concerned, the national entities have acted with no interference whatsoever on the part of any other organization. In this respect, their action has consisted although in a non-consistant way of the establishment of policies for the sector, direct expertise to user organizations, direct co-ordination with part of the public sector which does not come within their area of authority and the issuance of legal and technical norms by means of decrees, resolutions, manuals and technical guides, all of which has barely enabled them to orient the development and implementation of information systems in government services.

2. THE NEED FOR POLICIES AND THEIR ESTABLISHMENT

On the whole, public informatics policies are understood to be the general lines of action established by a government in that area. The policy is the result of a bureaucratic-political formulation process. The final result is a series of decisions establishing general guidelines for public action in a particular area and common goals to which all other decisions and actions undertaken in the sector must be geared hence involving extensive ramifications and a long-term approach.

A public policy should specify the strategic choices made by the government and the manner in which said strategies are to be implemented, that is to say, what is to be done, how, by whom and when it is to be done. It should also establish the follow-up mechanisms to ensure the implementation of the policy decisions and the strategies chosen. Once the strategic approach has been defined by an overall policy, the government must determine the tactics required for the implementation of the strategy and design operational plans. These lower level policies serve as a guide to action for public organizations and management.

The policy does not, in itself, tell top management how to handle a specific situation or tackle a particular problem. It is simply a general guide to action and, as such, it limits the choices that can be made.

The Central Government, by virtue of its position, can play a decisive role in the development of a policy for information systems. Like any other policy, this particular one will help the actors top management of these socio-technical systems to make clear decisions, will guide them in their activities and will focalize the actions of the organization itself.

As a guide to action, one critical element in policy formulation which is, at the same time, its major analytical exercise, is the ability to divide the overall strategy into separate sections in such fashion that it be practicable and not just theoretically sound.

Those who tend to consider this process as a rational procedure of individual decision-making overlook the already vast amount of knowledge available on the subject indicating either the application of a bureaucratic decision-making mechanism in which the positions adopted by the organizations participating in it with respect to the decision are influenced by their own internal operational systems, or the application of a bureacratic policy mechanism in which the actors, acting on the basis of power positions in the organizational structure, negotiate an agreement which takes the form of the policy promulgated.

Again, this process will be affected by:

a) environmental factors;
b) internal policies, and
c) the influence of units manoeuvring to gain advantages.

In order to understand this process it is necessary to take into account, above all, its organizational basis, for this has a definite effect on the result itself, that is to say, the informatics policy.

At a first level, a policy is presented in the form of a general declaration, a guideline defining the working concepts established by the Government in the field of information systems in the Public Sector, which actually operates as a broad umbrella, unifying second-level policies and more specific programmes.

It is assumed that this policy mainly announces the decision to initiate and expand automated information systems and specifies whether the aim is to create centralized or decentralized systems and whether priority is assigned to record type systems or those designed to help in decision-making; whether the central will act on its own initiative or in accordance with the demands of the agencies themselves; whether the application of the system is to be generalized, or on the contrary, certain areas and organizations are selected and assigned priority; whether the process of creation and expansion is to be accelerated or slowed; whether networking between systems is encouraged or not; whether the communication of data and information, etc., is encouraged.

From the point of view of its implementation, if an informatics policy is to be at all successful, in addition to requiring a clear statement of principles with a good technical backing, it must take into account:

a) the particular characteristics of the public sector;
b) that the organizations involved must operate as systems and not just as isolated entities;
c) that technology in the field of informatics is changing rapidly;
d) that in the process of adaptation of the information systems by organizations, important organizational changes take place.

In Latin America, governments did not begin to prepare a general informatics policy for the country, or a special one for the public sector, until the process of institutionalization of informatics, both in the society and in the State, was quite advanced. The creation of National Offices or Services, as has already been mentioned, arose from the need to limit the excessive amount of expensive equipment in government services and put an end to its inefficient utilization. Once this situation was under control, to a certain extent, attention was turned to the establishment of medium and long-term guidelines, which constitutes the basis of public policies in this area.

These National Offices, dedicated completely to the problem of informatics, were, from the beginning, of a strictly technical nature, in a limitative sense of the term. In other words, they were not concerned with the impact and consequences of their action, but only with the bases and strictly technical processes of informatics. Consequently, the public policies implicit in the actions of those organizations faithfully reflected the organizational environment in which they were designed.

The result of a technocratic and centralized process differs greatly from that of a techno-political process which is open to sectors representative of the Government and of the Civil Society. In the case of Brazil, where a Commission was created, comprising representatives of the industrial sector, of science and technology and of technology-user sectors, both public and private, bearing in mind the size of the Brazilian informatics market and the degree of technological development achieved, a national policy was established for the development of an informatics industry and technology. To this end, in order to encourage the development of the national industry, a specific measure was adopted reserving the domestic market for Brazilian products during a certain period of time and making the State, with its needs for computerized information systems and its purchasing power, the focal point around which the development strategy would envolve. Consequently, it was specified that the action of the National Office of Informatics (SEI), would be based on an active policy, directing, promoting and channelling the development of information systems in the public sector, but at the same time respecting the specific needs of the public entities set forth in their master plans. The central policy consists in harmonizing and co-ordinating these efforts at a more comprehensive level than that which is characteristic of an isolated NIO. In Brazil, the specific policy on the development of informatics in the Public Sector was subordinated to an overall policy for the development of informatics in the country.

In other countries, a process of formulation of a more rigid technical-bureaucratic nature resulted in a policy geared almost exclusively to consumption and to the application of informatics particularly in the public sector. This has been the case, up to now, in Venezuela where, except for a few timid efforts and initiatives, the policy applied has been totally implicit and based on the use and application of informatics technologies, with no active role assigned to the Central Office of Informatics itself.

In most countries in the area there is a combination of explicit policies on information systems in the public sector consisting of such general and vague declarations that they do not appear to have any particular effect on the operational environment of government organizations, and an implicit policy designed to control the individualized consumption of information products in those same organizations. In these cases, the National Informatics Organizations have offered their help in supporting processes and authorizing the establishment of information systems. The implicit policy allows for open competition between Systems proposed by user-units. These systems are eventually approved, provided they meet the requirements stipulated in norms and manuals. The greatest dedication and effort is witnessed at the level of specific project planning and not in the establishment of clear guidelines for the government Service as a whole or for its various sectors. The task has been performed, to a large extent, by systems engineers, working on the basis of specific projects, all of which goes to show the lack of vision and understanding of the phenomenon of government service as such.

There is an obvious lack of formulation of specific policies for the public sector.

3. PLANNING INFORMATION SYSTEMS

A national policy provides the direction and necessary legitimacy to the actions of a Central Office and its functions in the Government but, at the same time, it should encourage the planning, co-ordination and sound management of information systems. The planning of information systems as was stated in the Final Report of 1986 Senegal Meeting on the Role of Information Technologies (IDRC,1986) is an extraordinary vast issue, when understood in a sense which transcends the simple planning of a specific project.

As was pointed out on that occasion, there may be considerable differences between the methods and guidelines adopted for the planning of information systems at the strategic, tactical and operational level.

This broad field covers Central Government, decentralized regional and local organizations as well as State enterprises. to these must be added, on the one hand, national and local plans and, on the other hand, plans for information systems focusing on records and transactions or on the decision-making process in the public sector.

3.1. National and Sectorial Planning

This planning at national level must provide a unifying framework, without which the development of information systems within government services will result in a collection of unrelated sub-systems with no interface, creating unwittingly barriers to communications and staff redundancy.

The planning of information systems at national or sectorial level is of critical importance, bearing in mind that governments handle enormous amounts of information and that information and communications are crucial elements in the organizational and administrative process itself.

It can be argued, on the one hand, that Government is a non-integrated group of public agencies, each one with its own particular attributions, objectives and policies and tending to act independently of any other public agency. This is undoubtedly true, as demonstrated by the extensive bibliography existing on the subject (7). The manner in which the existing information systems have been established has helped to consolidate the internal position of each one of them and reinforced the tendency to work in an isolated fashion.

In fact, the existing information systems generally constitute a federation of sub-systems or worse, an archipelago of information systems which were designed to satisfy the needs of each functional unit, and in no case were they planned in an integrated fashion. The end result is an archipelago or conglomerate of unco-ordinated sub-systems, which is consolidated by the automation of said systems.

Thus, the information systems as a whole are poorly integrated, giving rise to considerable duplication of data and human efforts and, what is worse, the unability to share data. This type of archipelago is obviously of little use to top management as far as decision making and policy formulation are concerned.

But on the other hand, it is important to stress the fact, as McDonald did recently, that Government is also a group of interrelated organizations and agencies and must needs become increasingly so (McDonald, 1986b). All these organizations and agencies are subject to certain general, common policies, such as those relating to administration, finance or personnel. indeed, the latest trends in the implementation of broad economic or social policies require the joint, or at least co-ordinated operation of several or many State organizations. Hence, information systems must be designed in such fashion as to favour joint action by government units and consequently, careful planning and the invaluable contribution of modern informatics technology are essential. In this respect, planning I.S. at national or sectorial level must endeavour to provide for the necessary inter and intra-agency co-ordination, establishing linkages which are essential if government services are to function effectively. In brief, planning at national level is absolutely vital: a) for the development of national or inter-agency co-operative information systems; b) for the co-ordination of information systems between agencies and departments; c) to ensure consistency with national priorities and the goals of a national plan and, d) to allow for review or assessment.

With the relative exception of Mexico, in the countries studied, there are no national plans or programmes for the introduction of informatics in the public sector. In view of the real difficulties in implementing this type of planning, most of the experts interviewed were of the opinion that this type of project is Utopian for the time being. Nevertheless, the vast majority of them agree that sectorial plans should be implemented, assigning priority to the economic financial area and certain social sectors such as education. Along these lines, the Venezuelan authorities are getting ready to apply sectorial approach. However, up to date, there are no sectorial plans in force in the countries studied.

3.2. Organizational Planning

The same need for high-level planning as that described for the national or sectorial level applies to the more limited domain of a public agency or organization, the internal systems of which are disconnected and fail to take into account the needs of new systems, their priorities and their compatibility with the others which are already operating. To overcome this situation, it has been recommended that each organization design a comprehensive plan, called the Master Plan. In these cases the adoption of a master plan, which serves as a medium-term blueprint, can indeed improve designs. In effect, in the first place it enables one to pinpoint the objectives pursued by the introduction of informatics, since it demands a review of the project or projects, their definitions, missions, objectives and strategies; secondly, it reduces the uncertainty involved in their implementation and take-off; thirdly, it allows for the utilization of the appropriate available technolgoy in such fashion that it serves the organization's purposes and facilitates the control of expenses; and finally, it allows for the establishment of a system to control the operations of the information system itself.

The existence of a general masterplan for each organization helps:

1. To ensure that the use of the information system to solve a problem or problems will not be doomed to failure or even to disaster, by overlooking some details when designing or implementing a project.

2. To limit incompatibilities between complementary systems as far as possible.

3. To foresee the budgetary allocations required by complex and costly projects such as those involved in informatics.

4. To guarantee the coninuity of an activity, for in projects of this kind, much time elapses between their initiation and the beginning of the respective operations.

5. To estimate the impact they will have on the personnel working in these areas.

Neither are these types of plans to be found, in practice, in any of the countries studied. Even in Brazil, where the law relating to the SEI refers to the master programmes of the Brazilian public agencies, these are non-existent, or do not operate as such. The only exceptions to be found are some examples of these plans in State Enterprises which handle advanced technologies, such as the oil companies and other similar enterprises. The lack of master plans persists, despite the general recognition by the specialists of their utility and feasibility.

3.3. Project Planning

As has already been mentioned, at the less integrated level, that is to say for the project involving one unit of a public organization, it is also necessary to plan.

At this level, planning must be understood to mean the attempts to establish a frame of reference in order to link these technological resources to the objectives and goals of the corresponding organization or unit and determine the priorities in the actions and in the allocation of resources.

On the other hand, without planning there is no guarantee that the users' needs will be satisfied when the system begins to operate, neither is there any firm basis for the allocation of funds to the project, nor any yardstick to measure the operational efficiency. In other words, planning is essential to ensure the economy, efficiency and effectiveness of the project.

This is undoubtedly the only planning level to which the Latin American National Informatics Offices have paid any attention, developing methodological guides for the planning, design and implementation of information systems, as will be seen further on.

3.4. Planning and modernization in the Public Sector

As regards the planning of information systems, those persons in the region who are engaged in activities related to modernization and change in the public sector have directed their attention preferably to two objectives. The first is the linkage of automated information systems to transformation processes and improvement in government services. In this respect, the Commission for the Reform of the Public Administration in Brazil and the Commission for Informatics Policies in Argentina have been extremely clear in their proposals. In Brazil, the need was stated for the introduction of automated information systems to be, in itself, a component of the strategy for change (Gomes de Lima, 1985). The fact of establishing information systems which automate the systems already existing is condemned in these reports, on the grounds that this simply constitutes a process of modernization without transformation. The Argentinian Commission for Informatics Policies, on its part, has expressed the view that the first point to be made in any future informatics policy relating to the public sector is that the introduction of information systems must be closely linked to the process of Administrative Reform which that country is endeavouring to accomplish (Secretaria de Ciencia y Tecnica, 1986). These proposals have been submitted in the past two years and it is still too early to be able to appraise the results.

The second objective stems, to a certain extent, from the first one. Taking advantage of the new developments in mini and microcomputers, and particularly the innovations in communication systems allowing for the establishment of computer networks, it is proposed that advantage be taken of the introduction of information systems to bring about administrative decentralization. However, it soon became clear that the introduction of informatics alone does not result in decentralization, but it was also clear that it can help in this direction if it is based on a political-administrative project. There is today, in Latin America, an enormous opportunity to take advantage of technological developments in the aforementioned administrative transformation. In practically all the countries of the region with a centralist tradition even in those with a federal type of State structure there is strong pressure in favour of administrative decentralization, and this offers an interesting field of observation of the role which modern technology can play in support of an important administrative change.

The use of informatics technology to tackle these problems demands serious planning. In effect, as is stated in a recent United Nations report (1985), if one wishes to reap the benefits of a decentralized system, uniform government policies must be established to set minimum standards and encourage compatibility. The implementation of a new distributed system makes it possible to benefit from them ensuring flexibility and consistency. But on the other hand, according to the same report, a decentralized system requires a centralized control station. Without adequate planning, the inevitable result is that incompatibilities in equipment or in the systems themselves are an obstacle to its implementation and, at the same time, create a redundancy in data collection, system development, equipment and staff, a situation which is far from encouraging.

It is not only this latter problem but both problems require a certain degree of planning at a higher level than that of an organization, but such planning has been practically non-existent in Latin America up to now.

4. UTILIZATION OF METHODOLOGIES FOR THE DEVELOPMENT OF INFORMATION SYSTEMS

The attempts on the part of the National Informatics Offices to provide guidelines for the development of information systems in the public sector have consisted of: a) policies for the development of informatics in the Government; b) sectorial or master plans in an organization; c) direct expertise from their technicians who support or do the work, and d) the development of methodologies for planning and designing information systems, guidelines for service contracts or for the assessment of Data-processing Centres, etc.

A comparative study shows the development of various types of methodologies or guidelines designed to help in the development of information systems. On the one hand, there are technical guides or recommendations on very specific elements of said systems, such as types of machines, recommendable programmes, peripheral elements, etc. At the other extreme are comprehensive methodologies for systems planning, designing, implementation and assessment. In these cases, the whole development process of the system is under control. These methodologies almost always consist of voluminous manuals accompanied by all the necessary forms for the tasks described in the methodology. Between these two extremes there are more or less comprehensive and more and less documented methodologies.

Our attention will be focused on the more formal methodologies, similar to the second type. The guidelines provided by these methodologies for the development of information systems in the public sector are based on the experience acquired and processed by the systems developers. In this respect, they refer to the planning, organization and monitoring of the efforts devoted to the development of the system. Most of them indicate, in a very analogous fashion, the various phases of the project and their requirements, emphasizing the following aspects: a) identification of information needs; b) specification of the objectives of the information programme; c) user applications, and d) the technological, material, financial and human resources required. The methodology organizes a large number of intricately related tasks in a series of steps, in such fashion as to ensure that the project will be useful to the users. In short, the methodologies guarantee that the planning and designing will be carried out by means of steps and practices which have already proved to be effective. The planning proposed by these methodologies should be understood as an attempt to establish a common frame of reference to determine priorities in the activities and tasks to be undertaken and in the allocation of resources. Furthermore, it allows for the establishment of the appropriate linkage between the application of the informatics resources and the needs, objectives and goals of the corresponding organization or unit.

If the project is not planned and the steps indicated in the methodology are not followed, there can be no certainty that the organization's information needs will be satisfied. Neither would there be any standard to measure the operational efficiency of the system, nor indeed any basis for the allocation of funds to the project.

The application of uniform methodologies, on its part, offers certain advantages in the public sector's information system as a whole. (UN, 1985). In the first place, it helps to establish co-operation among the public agencies which already have, or are developing information systems and, in the second place, it enables those organizations to exchange experiences in the use of human, material and technical resources.

5. INTERNATIONAL EXPERIENCE

International experience in the use of formal methodologies to plan and design information systems in the public sector includes a wide variety of examples, of which the following are of particular interest in view of their significance for the Latin American situation: a) the Canadian Systems Directorate's System Life Cycle Process; b) the French RACINE and c) the planning guides of the State of Florida in the USA.

The Canadian Systems Directorate's System Life Cycle Process, as its name indicates, is a typical case of a "system development life cycle" which consistently reflects a basic pattern followed in most of the methods developed in Latin America. In this method, the planning and designing of an information system in the public sector follows a clearly defined pattern of development by pre-established steps and stages, which guarantee that all the requirements of the system will be taken into account at the appropriate time. (See appendix 1).

At the initiation of the project, in order to ensure, on the one hand, that it is necessary and, on the other hand, that it will be well conducted, a sponsor is required -normally a Supply Administration Officer- who appoints the project manager. If the importance of the project so requires, a steering committee is also appointed.

As is the case in most of these methodologies, the planning is divided into several phases, in this case, seven: a) project initiation; b) requirement and feasibility study; c) functional analysis; d) general system design; e) technical development; f) implementation, and g) production.

These phases, however many there may be and whatever the name given them, generally correspond to: a) planning; b) analysis of needs; c) the logical design; d) physical design; e) implementation, and f) conversion. In some cases a phase g) post-implementation and assessment is added.

In the Canadian model, the responsibility for the development of the system is assigned jointly to the user unit and the Systems Directorate, with preponderance of one or the other depending on the degree of technicality of the phase. The first phase, "project initiation", is the responsibility of the user unit; the second phase, "requirement and feasibility study", is entrusted to the user unit, with assistance from the Systems Directorate. The third phase, "functional analysis", is the user's responsibility, with the participation of service organizations. The fourth and fifth phases, "system design" and "technical development" respectively, are the responsibility of the Systems Directorate, with assistance from the user organization. The "implementation" phase is again the responsibility of the user unit, with the participation of the Systems Directorate. As can be seen, this methodology involves practically all the stages of planning and designing of the system, with particular emphasis on the "functional analysis" phase, in which a detailed analysis is carried out of the users' requirements, a crucial factor for an efficient development of the system.

As has already been mentioned, this Canadian model is followed closely by all the Latin American countries.

France has developed what can be considered as one of the most complete methodologies for planning and designing information systems. In a remarkable effort in support of this process and under the sponsorship of the Ministry of Industry, three important guides have been prepared and published: a) a methodology for planning administrative information systems (RACINES); b) a methodology for designing information systems (MERISE), and c) technical guides relating to employment problems and work conditions in an information system (ACTIF).

In the case of RACINES, the planning process is divided into the following 5 phases: 1) User awareness and feasibility study; 2) study of existing situations and choice of general goals; 3) elaboration of three alternative scenarios for future development based on: a) continuation of existing trends, b) a maximum usage of techical possibilities, and c) a compromise solution; 4) detailed elaboration of the chosen scenario, and 5) preparation of an implementation plan.

For the development of the project, a steering committee is set up, which, at the end of each phase, must approve the result obtained.

As regards documentation, this methodology has abundant information, with check lists and forms for all the activities to be developed.

Its use is now compulsory in the French Ministries for the quinquennial reviews of informatics plans.

In addition to the detailed and comprehensive nature of this type of methodology and the fact that it is well documented, there are two other characteristics worthy of note, in view of their exemplary value: a) it prescribes a permanent review and assessment by the steering committee of what has been accomplished in each phase of development, and b) above all, it specifies the need to present alternative scenarios for future development. This latter characteristic is of particular interest, for it reflects an orientation towards the future, in an environment where technological development and the needs for new types of information grow at an explosive pace.

The last case is that of the planning guides of the IRC in Florida. In recent years, the State of Florida in the USA has established a State system of planning of information resources. One of the elements in this complex management of planning at State level is the preparation, every two years, of guides for the planning and information systems for the various State administration agencies. (Davies and Hale, 1986). The aim of these guides is to facilitate planning both for informatic professionals and for information programme managers. They provide concepts, definitions, reporting schedules, etc. and they are prepared in such fashion that they make sense even to managers whose work does not involve data-processing. The first guides produced identify four major blocks in plan-building: 1) the agencies' or unit's goals and objectives; 2) the objectives and goals of the information programme; 3) user applications, and 4) the material, technical, human and financial resources required by the system. This sequence ensures the efficient linkage of the technological resources to the unit's or organization's goals and objectives.

For the purpose of developing a project, public units or organizations can request the support of private technical consultants for the preparation and design of the plan, provided they conform to rules established in the guides.

This case offers no particular characteristics as far as the methodology itself is concerned. Nevertheless, it is important to note: a) the great effort to make these guides comprehensible for all managers, including those who are not directly involved in data-processing, and b) the attempt to involve top management in the systems development process itself.

The effort to develop plans in a co-ordinated fashion, with a field of application covering the whole State of Florida, is particularly worthy of note. In this respect, the Committee in charge of this planning favours the connection and compatibility between systems.

The examples chosen show the widespread use of these formal methodologies today in the public sector of the developed countries. What is even more important, from the standpoint of this paper, is the fact that each one of them possesses certain, very special characteristics and specific aspects, which have been highlighted, for they deserve to be taken into account in any use which may be made of these methodologies in the developing countries.

5.1 The Latin American Experience

Several of the aforementioned support mechanisms for the development of information systems have been applied in Latin America but, as has already been explained, since, practically speaking, neither the specific policies nor the sectorial or master plans have been put into effect, and direct technical assistance has been extremely limited, the main contribution of the NIOs to control the development process has consisted in promoting the use of methodologies through guides and manuals.

A great many Latin American countries have experimented with methodological guides in the past 10 years (Mexico began to use them in 1973) and they have served effectively for the planning and designing of information systems for public agencies or for some of their units. They have been used by these user-units in compliance with legal provisions and because their proposals for in formation systems required the approval of the respective NIO, but in practice the users have not always followed these procedures.

Since the first obligation assigned to the National Offices in charge of informatics in the Public Sector was that of controlling the renting or purchase of costly computer equipment and the respective services, their first task consisted in demanding that the various public agencies to justify each purchase or renting of informatics services or equipment, and their first contribution to the process in almost all cases consisted in establishing model contracts or introducing compulsory clauses in the formalization of legal relations between public entities and the companies supplying said services.

However, owing to the vast field which the National Informatics Offices have had to cover in the majoritiy of cases with insufficient staff, together with the variety and complexity of the task of controlling and supervising the development of information systems, they have tended, rather, to develop methodologies for planning, designing and implementation of refered systems in the public sector.

In the case of Latin America, we shall review, in some detail, two methodologies which are in full use: that of Argentina, very recent and brief, and that of Venezuela, established a few years ago, which has manuals and some documentation.

5.2. Argentina

In the Argentinian case, the methodology consists of the "Guide for Planning Informatics", the first version of which was prepared and put into effect by the Undersecretariat of Informatics and Development in 1987. (Secretaria de Ciencia y Tecnica, 1987).

Like the vast majority of these guides, this one follows the pattern of the System Development Life Cycle, as can be seen from Annex 2.

This guide is presented as "a tool to help in the preparation of a plan of information systems" and the use of which "facilitates the formalities, analysis and decision by the office of the Under-Secretary as to the purchase or renting of elements of information systems". (1987). In this regard, although it is offered as a help, practically, it is obligatory, since the Office of the Under-Secretary is the agency which is empowered to grant or deny authorization for the purchase or renting of the necessary instruments for the proposed system.

In accordance with this methodological guide, the development of an information system consists of three main stages, each one of which is divided into several phases.

The first stage is called "outline for the promotion of the systems plans" and its aims are to sensitize and involve the highest authorities of the organization as regards the need for the systems plan, to establish the feasibility of the development of the process and to generate the necessary conditions for it to be well conducted. The stage concludes with a profile report on the plan. The second stage is the "systems plan" itself, consisting of the following phases: a) collection of the information involved, its organization, costs, the related systems and their failings; b) detailed analysis of the information collected, proposed solution, resources, personnel and costs; c) structure and result of the plan in which the detailed design of the system is set forth; d) detailed report containing the whole design, contemplating resources, personnel costs and budgets and a study of the efficiency of the system, and e) assessment.

The third stage involves the development and implementation of the system.

In this respect, it is important to note certain features of particular importance, which reflect situations characteristic of Latin America.

1. In the initial phase of the process, the involvement of the highest authorities of the user-organization is strongly emphasized. This does not refer to the authorities connected with the technical aspects, but to those involved in the top-level political aspects of the organization. These authorities must undertake to support the project. This support is essential in a situation of permanent shortge of financial resources, above all when new funds are sought, or a redirecting of other funds to the new project is required.

2. It establishes the obligation to carry out a series of broad consultations with a view to obtaining support for the project within the organization. These consultations must be held with a) the high-level authorities of the organization; b) its technical and administrative staff; c) the persons in charge of the information sector; d) the equipment and software suppliers, and e) the authorities of other units or agencies with which functional relations exist in the respective work area. In these consultations, the methods, norms, standards, distribution of information, common applications, etc. are reviewed. These consultations are of crucial importance for the creation of interrelated and compatible systems and to avoid the establishment of islands of information.

3. It creates the Users' Committee, comprising representatives of the various sectors connected with the system. This Committee evaluates each stage and each phase of the project. It has broad attributions, including the right to suspend the project if, at the conclusion of its gross design, the Committee considers it to be inadequate or inappropriate.

4. Together with the permanent evaluation of stages and phases, it carries out a final and particularly careful assessment of a triple nature: a) a technical assessment of the Detailed Report by the users themselves; b) an assessment of the legal aspects involved, and c) a general assessment carried out by the Users' Committee.

5. In its technical part, the gross design phase receives relatively less emphasis in the Guide than the parts corresponding to the systems plan. This may be a delicate matter, for it implies that the determination of information needs by the users may be incomplete. However, in view of the schematic nature of the instrument and its lack of documentation, one cannot conclude that in practice this phase is not emphasized.

6. The informatics projects to be developed are classified in accordance with their importance, and criteria are presented for the distinction between a) limited projects, b) others of broader scope and greater importance and c) those of very broad scope and great importance. The appropriate steps to follow are indicated for each category, thereby avoiding the need for very different types of project to adjust to steps which are of no importance to them, as often happens with other methodologies, which do not provide for this differentiation.

7. The distinction is also made between administrative, technical , control or decision-making projects. This differentiation does not, however, affect the list of steps to be taken, and they are all treated in accordance with the general rules. This situation indicates a weak spot in this guide.

8. Lastly, this document, intentionally, does not go into great detail. It refers only to those points which the Office of the Under-Secretary considers to be indispensable for efficient planning and design. For that same reason, the relevant documentation is not attached.

5.3. Venezuela

The General Division of Informatics of the Central Statistics and Informatics Office has gradually developed a series of methodological guides for use by those organizations of the public sector which intend to set up or expand an information system. Compliance with those instructions is said to be prerequisite for the CSIO's approval of the new system and authorization to purchase the equipment and accesories required by the project, but in practice they are not always followed.

One of the aforementioned guides gives the details of the Network of Activities for the development and installation of an Information System. In the part relating to the subject of this paper, the following phases are specified:

a) Project initiation, in which the information needs are specified, as well as the objectives and limitations of the project itself, and a group is appointed, to which the responsibility of carrying out the project is assigned.

b) Selection of systems personnel to begin the planning and implementation of the project.

c) Planning, divided into two parts: I) definition of the System, or feasibility study, in which the possible alternatives are presented and their economic, technical and legal feasibility studied; and II) specification of the system in which the task continues with a functional description including inputs, outputs, processing operations, additional data, etc. and the assignment of material and technical resources such as hardware, software, data bases, files, etc. Also includes the contraints of the system such as the external environment, interfaces, etc. It concludes finally with cost determination and the schedule.

d) Project assesment, carried out by the CSIO, which determine whether the system achieves the objectives, whether the specifications are adequate for the system, whether the resources are well assigned and, finally, whether the implementation of the project is justified.

In accordance with the basic criterion followed by the methodology, namely the strict control of equipment purchases, the following steps are detailed in the Network of Activities: e) selection of suppliers; f) evaluation of suppliers; g) preparation of contract; h) contract evaluation; i) selection and recruitment of personnel; j) reception and installation of equipment and k) implementation and test.

In this case also, the following special characteristics of the guides are to be noted:

1. It is stated that these norms apply to all types of projects, but no reference is made to their possible scope. It is also stipulated that they are also applicable in the case of substitution or increase of the available equipment.

2. As regards project management, an Informatics Committee must be appointed, chaired by an official of the highest possible hierarchical level and comprising the persons responsible for the Data-processing Unit, Organization and Methods and the Administrative areas directly related to the system proposed. This Committee monitors the progress of the project, defines its objectives, maintains the liaison with the substantive areas and sets up a Technical Committee. This Technical Committee is in charge of the detailed designing of the system. It is made up of officials acquainted with technical knowledge of informatics, as well as with the policies and organization of the agency, and is headed by a member who is, at the same time, a member of the Informatics Committee.

   According to the guidelines, it is the officials of the user-unit who determine the information needs at different levels and ranks. The analysis and criticism of the present system, the alternative solutions and the choice of the best alternative are incumbent upon the Informatics Committee. The definition of the proposed system is the responsibility of the Technical Committee, which also determines the equipment and programme systems required.

3. The user-unit can request technical assistance from a member of the General Division of Informatics of the CSIO when setting up the Technical Committee. If the unit lacks skilled personnel for the task of planning and designing the system, it can hire the services of a private firm of consultants, whose work is governed by the same rules as those of the Technical Committee.

4. No partial assessments are carried out during the development process. Only a general assessment is prescribed, on the basis of the report presented by the user-organization to the General Division of Informatics of the CSIO. That is to say, the final assessment is the only one.

   In these circumstances, the relationship between the CSIO and the user-organization may be very tangential. Once the CSIO has authorized the initiation of the development process, it may well be that it does not intervene any more until the final report is presented for its evaluation.

5. The feasibility aspects are well taken into account, for a presentation of alternatives is required, as well as a cost/benefit study.

As can be seen, the whole set of guides is basically geared to the control of equipment purchases. In fact, a system which does not need to purchase equipment does not have to go through the process established by the CSIO.

6. APPRAISAL OF THE USE OF METHODOLOGICAL GUIDES

From the point of view of a National Informatics Office, the development of these methodologies enables them to ensure that the task of developing an information system, which is usually performed independantly by the Organization concerned, or sometimes by private consultants hired specially for that purpose, will follow a certain standard procedure, with clearly defined phases and steps. In these cases, the methodology, with its minimum obligatory requisites, serves as a common frame of reference for them, thereby enabling the National Informatics Office to exercise control over the results of the studies and the reports which the user-organization is obliged to present in relation to the system.

The use of the methodologies has enabled the National Informatics Offices: a) to guide the development of information systems in the public sector in a uniform fashion; b) to make mandatory for the public organizations to make systematic and rational use of a series of standard criteria and processes in the development of their information systems, and c) to assess and control the developments in each organization in a much more effective and economical manner.

In the case of Latin America, in the absence of specific policies for the development of information systems in the public sector, the methodological guides, more than acting as a help in planning, have mainly served the purpose of standardizing the applications made by the user-organizations to the National Informatics Offices for the purchase or hiring of informatics services and equipment. This function helps the NIO to control expenses, facilitating its role as supervisor and controller, but it does not form part of a coherent policy for the development of information systems. The inspectoral function takes precedence over the development function.

From the point of view of the user organizations, the use of methodological guides based on the System Development Life Cycle for the planning and designing of information systems has enabled them to achieve an acceptable degree of efficiency and effectiveness in each one of the systems established, bearing in mind that the vast majority of them are record and transaction systems. In effect, to put it briefly, it can be said that their use has: a) facilitated project development; b) has led to the achievement of compatibility between the organizational goals and the technical means available; c) has obliged them to consider alternative information systems in the same area of interest; d) has obliged them to assess the costs and benefits of the project, thereby guaranteeing economic rationality; e) has enabled them to evaluate (although not always) the tasks accomplished in the development of the project. As regards the procedure followed in the handling of the project, the methodology has served: a) to organize the development activity; b) to determine who are the actors and participants in the project, involving the end user, the technicians and managers related to the system to be installed, and c) to decide what to do by means of norms, checklists and forms.

All the aforementioned elements undoubtedly constitute a strong argument in favour of the use of formal methodologies. However, it is important to note certain weak points in the methodologies in use, which detract considerably from their efficacy.

These weaknesses do not appear uniformly in each country. In the first place, not all the guides are sufficiently comprehensive or detailed, nor adequately documented, for them to be as useful as they should be. In the absence of these elements, these methodologies guides take on a strong formalistic connotation and become a mere formality.

Secondly, in general, the process of determination and specification of information needs by the users is not, in itself, emphasized, the fact of which is detrimental to the use which is subsequently made of the system. These guidelines give no clear indication of how to work with the various hierarchical ranks of the organization, in order to determine information needs from the bottom up and to ascertain the requirements of co-ordination of that information, which is only possible when one proceeds from the top downwards.

Thirdly, emphasis is not placed on the need for an assessment to control each phase of the planning and design process, it being left, sometimes, to the respective NIO to assess the final product.

On the other hand, we must point out that by its very nature, the methodology uses the "project" as a unit, understood in terms of its limited scope and time.

Most of these projects satisfy the specific needs of a unit of a public organization. In accordance with the principle -which is correct- that the petition must come from the lower levels, which is where the need for the system is felt, it is the adequate response to that unit's specific needs which is stimulated. However, there is a tendency to lose sight of the point of view of the government as such, which needs its units to act in a co-ordinated fashion in order to achieve an impact on the environment in which it has to act. In an environment such as that of the public sector, which is, in fact, fragmented, this type of mechanism tends to further accentuate that fragmentation. Although some methodological guides demand a study of the relation existing between the system and other systems of the same, or other organizations acting in the same functional area, the fact is that for tactical and economic reasons, this requirement is not met as fully as it should be. The very mechanisms of the methodologies, such as they are used in Latin America, provide no incentive to encourage compatibility between systems, to guarantee communication and the exchange of information between them. This tendency should be taken into account emphatically in the methodology itself. However, the whole responsibility for the present situation can certainly not be attributed to the methodologies, but rather to the NIOs, which have failed to play an active role as regards policies or plans to stimulate these basic criteria of compatibility, communication and exchange of information and, what is more, to encourage the creative use of information technology by the user-units and organizations.

7. PROBLEMS AND ALTERNATIVES IN THE USE OF METHODOLOGICAL GUIDES

Based on the experience of developed countries in the development of information systems in the public sector, we can turn our attention to certain difficulties which have arisen with System Development Life Cycle type of methodology, such as it has been used up to now (8).

7.1 Critiques to SDLC

As the record and transaction systems gradually satisfied the needs of the middle management and operators of public programmes, it became increasingly evident that the higher authorities in charge of formulating public policies and making decisions needed not only the aggregation of the information produced by the records, but a different type of information system.

The term "information system" is used in reference to both "management information system" (MIS) and "decision support system" (DSS), thus masking a significant qualitative difference. Management information systems are transaction-based systems that seek to summarize data for routine and structured managerial decision-making. This MIS generally summarizes data produced by transaction-based systems (data on personnel, budget, salaries, services provided, facilities, inventories, etc.) and stored in organizational data bases for use by operational and middle level management. (Rubin, 1986). On the other hand, "decision support systems can be defined as a computer information system which provides information as the basis for non-routine, semi-structured decision-making. Decision support systems contain a language component that facilitates inquiries, a knowledge component that contains the data base and a problem-processing component that contains the models used to generate alternative solutions. It is the problem-processing component that distinguishes a decision support system from a management information system". (McGrowan and Lombardo, 1986: 579). One of Rubin's central arguments is that these different information systems have different design requirements, a typical SDLC methology being inappropriate for the development of a decision support system.

Our concern is that in Latin America, in the near future, once the field of the present information systems is relatively complete, the most important developments will take place in the field of

Decision Support Systems. Hence, it will be necessary to revise the methodologies currently in use, to adapt them to the new priority needs.

Even considering the planning and design of a traditional information system, the main criticism of SDLC is aimed at its lack of flexibility. In effect, once the functional design phase, in which the users identify their information needs, has been concluded, that identification process is also closed definitively. The next phase, that of the detailed design of the system, takes those information needs for granted. In the traditional application of this methodology, as it is practised in Latin America, the possibility of repeating the phase of identification of information needs is not envisaged. As Rubin points out, the users are asked for a sign off on the specifications required quite some time before the implementation process begins. This should oblige the team responsible for carrying out the project to make an exhaustive effort in the pre-implementation phases, particularly in the part corresponding to the identification, by the users, of their information requirements. In this case, the analysis of needs and functional design should be done in conjunction with the system staff and the users, both middle level technicians and top management, in permanent consultation, for the information requirements must be established from a double standpoint: a) bottom-up, to ensure that the most elementary and specific functional needs are satisfied, and b) top-down, to satisfy the top-level needs and provide co-ordination, which can only be guaranteed by top management.

The special attention to this part of the system's development and the emphasis placed on it reflects the concern with the fact that the most frequent cause of information systems failure can be attributed to mistakes made in the detection of information needs and requirements of the various users. It is not surprising, therefore, that these phases of functional tasks such as planning, analysis of needs and logical design have become increasingly important, both as regards the amount of time they absorb in relation to the total time spent on the development, and the amount of human resources assigned to these tasks. A United Nations report (UN, 1985) states that in the case of Canada, 70 per cent of the time and 49 per cent of the staff resources were spent on the first phases of analysis and design. The same report refers to similar cases in the developing countries. Nevertheless, the basic assumption underlying this effort is that the users are in a position to present a complete specification of their information requirements before the system is designed. This may be relatively true in common cases of information systems, but it is much more complicated in the case of DSSs.

The second problem related to the lack of flexibility is that in the present system development process, once the implementation phase has begun, any revision of the system, due to a need for more or different information, is extraordinarily expensive.

One of the solutions to this problem, as has already been pointed out, has consisted of a greater involvement of all types of users in the designing of the system. In most cases, an attempt has only been made to consult them in each phase of development. However, it has been recommended - and in the case of Argentina, this is being done- that these users be included in the Committees authorized to make decisions at the end of each phase or important step in the process.

The second alternative solution consists in developing a different design strategy, using prototypes and iterations, to make sure that the users' information requirements are taken well into account in the information system. In this case, it is assumed that the user cannot state his needs completely until he has had the opportunity to work with the system. It is the operation of the system itself that provides the user with the possibility of clarifying his needs.

7.2 The heuristic design and the prototype

In this approach, in order to ensure the necessary flexibility, the use must be provided with a prototype before the end of the period in which new data requirements or specifications can be presented for the information system. The operational prototype is equiped with an output screen and report generation components, allowing the user to develop interactive dialogues. Both the user and the managers can gain experience working with the system and exploring the outputs and their use, whereby they can determine new information requirements heuristically. The addition of this phase to test a prototype of the kind mentioned gives the design sufficient flexibility to adapt the system to the users' real needs. This proposal was taken to its logical conclusion by Nauman and Jenkins (1982), who have suggested that the prototype be used not as a complement to the SDCL, but as a substitute, and using an iterative technique to improve the system in each cycle. In this case, the system's analysis, design and implementation phases are incorporated into this process of reiterated cycles, and this iteration enables the elements of the system to converge in a stable set. However, it has been demonstrated that total replacement does not operate efficiently and that it is preferable to use these methodologies as a complement to the SDLCs (Marius and Smith, 1985).

Rubin has argued convincingly that in the case of decision support systems, even a version as flexible as those described does not provide consistent support for their development. In view of the fact that, in the case of the DSSs, the user's needs must be considered as a moving target to which the system must adjust, giving the user a completely flexible environment for the processing of his information, he suggests the use of a method based on the SDLC but with the incorporation of a prototype which remains in permanent iteration, since it is not designed to converge in any static set of requirements. In this methodology, the various prototypes are considered as an operational version of the system, always leaving open the possibility of incorporating new elements. Each cycle follows the traditional phases of analysis, design, implementation, operation and assessment. An example of this type of methodology is the Iterative System Development Cycle. (See Annex IV). This idea may appear to be very attractive, since it provides the user with a very flexible instrument, but the fact of leaving it open permanently to the possibility of new develoments implies certain requisites related to technical support and availability of resources, which are not always easy to satisfy in the Latin American administrations. It may be very useful to provide a degree of flexibility which is absent in the SDLCs, and one or two convergent iterations with a prototype may satisfy that requisite, but the idea of leaving open, permanently, the possibility of expanding or changing the system does not seem to be a viable alternative in the region.(9)

What is clear from this discussion is that the design requisites of information systems of the DSS type presuppose the completion of the SDLC-based methodologies with the use of prototypes and iterations which garantee their flexibility.

In summary, based on the assumption that in the near future there will be a substantial growth of the DSS in the public sector and that, at the same time, there is a need to increase effectiveness and take better advantage of the traditional information systems, it is necessary to introduce modifications in the SDLC-type methodologies used in Latin America, with a view to making them more flexible in order that the users can specify correctly their information needs. To this end, it is suggested that production phases and the use of prototypes be incorporated in the SDLC, in such fashion that the users have the opportunity to work with the system for a time, thereby ensuring correct specification of their needs and hence a more efficient information system.

8. RECOMMENDATIONS

Based on the study of the need for methodological guides and of the use made of them in planning and designing information systems in the public sector, the following recommendations can be made tentatively with regard to their content and use in the developing countries:

1. It is necessary to recognize the important role played by the methodological guides in the planning and development of information systems in the public sector.

2. These guides should be developed and established in the countries as a necessary resource, since:

a) they help to ensure that the technical, material and financial means are organized consistently, in such fashion as to achieve the organizational objectives pursued by the establishment of the information system;

b) they help to standardize procedures and contribute to an orderly development of information systems.

3. When developing new guides or modifying those already in existence, an effort should be made to make sure that they are comprehensive, that they include all the important steps involved in the planning and design of the information systems and that they are accompanied by the necessary documentation to ensure that they will perform their task adequately.

4. The methodological guides should help to guarantee:

a) that the gross design, and particularly the logical or conceptual design, be accomplished completely, in detail and extremely carefully. Hence, the guides must contain special instructions, drawing attention to the need for, and importance of this phase.

b) that the design is flexible. This can be achieved by means of prototype and iteration mechanisms and by determining the information needs through a combination of top-down and bottom-up processes;

c) that the technical and economic assessment of the systems proposed is carried out in strict accordance with professional standards, in order to ensure that the investment made receives the same treatment as any investment project in the public sector;

d) that due consideration is given to the differences between management information systems, or decision-making support systems.

e) that alternative scenarios are constructed, in an approach oriented towards the future. This orientation is of fundamental importance in a field such as that of informatics, the innovation capacity of which is explosive, and in an area such as the public sector, which is in full modernization.

f) That the systems are compatible and can communicate with each other, within the limits of an organization or a sector of public activity, depending on the particular needs. This is an essential requisite if the public organizations are to increase their capacity for action.

g) That top management is involved in the planning and designing of the system, thereby meeting certain special information requirements and helping to co-ordinate with other systems.

5. The application of these guides in the planning and designing of new systems or in significant expansion of those already existing should be made strictly compulsory.

6. Their important role is planning and designing the system should be recognized, but at the same time, it should be understood that it is a limited role, which ensures that the internal components of the system are consistent with the goals of the unit in which said system is installed. Consequently, the basis must established for a possible linkage with other systems inside the organization or with those of other organizations engaged in activities in the same functional area or sector.

7. The use of these methodologies in Latin America must be complemented by the utilization of sectorial programmes or master plans and, above all, with the application of active policies in the respective NIOs.

   The general policy declarations must be complemented by policies, the specificity of which is sufficient to ensure operational consequences. These policies must provide creative stimulation for the application of informatics technology, in order that it contribute efficiently and effectively to the achievement of the objectives and goals of the public sector. To this end, it must promote:

   a) compatibility between systems and equipments;
   b) communication between the systems, in such fashion as to allow for an optimal flow of data within the systems of the public sector;
   c) the establishment of networks for the operation of information systems;
   d) adequate permanent technological innovation in the information systems.

Finally, as regards our knowledge of the use of methodologies, a line of research should be established, with a view to a systematic study of the application of various types of methodological guides, their benefits and shortcomings, for different types of information systems in the public sector, as well as the specific characteristics of this sector, which call for particular contents of said methodologies.

NOTES

1. According to Bozeman and Bretschneider, there are significant differences between the public and the private organizations management mainly in economic authority, political authority, work context and personnel systems.

   Those differences affect the design of information systems in the public sector. For example, the prescription for planning and evaluation of I.S. projects, are different. While the planning in private organizations should be intraorganizational and holistic, in public organizations it should be extraorganizational and incremental. While the evaluation of an I.S. project in private organization is based on economic efficiency alone, in the public organization it should add political efficiency and political mission, as criteria, etc. See Bozeman and Bretschneider.(1986).

2. On this point, for the Latin American experience, see: Orellana and Rodriguez (1984 and 1985). SELA/IBI (1986).

3. On organizational arrangements and information policies, in Argentina. See: Orellana and Rodriguez (1984). Chervatin (1982). Secretaria de Ciencia y Tecnica (1985). Secretaria de Ciencia y Tecnica (1986).

4. On organizational arrangements and policy statements. Orellana and Rodri guez (1984). Gomez de Lima (1985) and Fregni (1986).

5. On organizational arrangements and policy statements in Mexico. See: Ore llana and Rodriguez (1985). SELA/IBI, (1986). Secretaria de Planificacion y Presupuesto (1979). Secretaria de Planificacion y Presupuesto (1982).

6. On organizational arrangements and policy statements in Venezuela. See: OCEI (1984). Sutz, Judith (1986). Estrada, Zaida (1987).

7. This fact has been highlighted by all those who work using the bureaucratic politics' approach to public organizations. An excellent statement according to this approach is D. Yate. Bureaucratic Democracy (1982). For Latin American works on this subject see: O. Oszlak (1980 and 1984).

8. In this section, I follow closely the arguments of Rubin (1986).

9. For a good example of a prototyping application to public administration, see: M. Hurley and Wallace (1986).

ANNEX I.

CANADIAN SYSTEM DIRECTORATE'S SYSTEM LIFE CYCLE PROCESS (UNO, 1985)

Phase	Steps
1. Project initiation	- establish the project and identify responsibilities - conduct preliminary analysis - identify preliminary project plan and budget - provide management endorsement.
2. Requirement and feasibility study	- analysis and review of general requirements - identification of alternatives - economic and technical feasibility studies - preliminary cost-benefit analysis - management endorsement.
3. Functional analysis	- analysis of detailed user requirements - identification of functions - definition of interfaces - definition of input, output and information flows - determination of time, cost, performance and security requirements - conceptualization of a model of the system - refine overall project plan - highlighting of cost and benefits.
4. General system design	- technical analysis and design - finalization of the data dictionary - identification of technical standard to be used - outlining of the methods of operation and back up - specification of hardware/software system performance criteria and security considerations - identification of conversion plans - identification of special training requirements - refinement of planned estimates.
5. Technical development	- develop detailed program logic - to code and test programs - to develop user manuals and procedures - to develop conversion, training and operations manuals - to develop a system test plan - to conduct an integrated system test - to develop a user acceptance test plan.
6. Implementation	- users conduct acceptance testing of the system - organization conducts user and operations trainning - creates finalized documentation - carries out parallel operations.

7. Production

- periodic enhancements
- initiation of data entry and system output
- maintaining quality assurance, quality control and logs for audit evaluation.

ANNEX II

ARGENTINA

Stages	Phases and activities
1. Outline for the promotion of systems plans	- sensitizing (consultation with the heads of the organization,the administrative systems plans technical managers, the head of the informatics unit and heads of related organizations in the public sector.
	- Strategic and technical features (write a report including technical recommendations, basic arguments, a proposal of a study and its schedule).
	- Plan profile (primary and secondary objectives, expected end-product, project feasibility, viable endalternatives, estimated resources, set up of users committees).
2. Systems plan	- Evaluation (Evaluation of first stage).
	- Collection of information (a- information involved in present system, sectors involved, information flows, machine support, procedures; b- structuring of information; c- resources required; d- costs; e- related systems; f- shortcommings of I.S. and needs not satisfied; g- assessment).
	- Analysis (a- detailed analysis of collected information; b- detailed analysis of shortcomings and possible solutions, alternatives; c- proposed solution, information flows, sources and destination, required support; d- design of new procedures, analysis of changes to be introduced, general design of new system; e- required personnel; f-costs; g- schedule; h- assessment.
	- Structure and result of plan (a- detailed descrip tion of archives; b- detailed description of inputs and outputs; c- general description of the processes, software, utilities; d- training of users).
	- Detailed Report (a- resources: detailed configuration of support equipment, software requirement, personnel requirement, equipment; b- budget: investment in equipment and software, investment in auxiliary facilities, annual operative budget; c- legal report; d- efficiency and cost comparison between the old and the new system; e- security norms and procedures).
	- Assessment (a- technical evaluation made by users; b- legal evaluation; c- general evaluation).

3. Development and Implementation of the system	- Personnel training. - Fulfilment of legal requirements. - Detailed description of new system (a-analysis and detailed design of the structure and results of the plan; b- manuals and procedures; c- schedule control and adjustment). - Programming (a- programming installation of equipment; b- programme documentation; c- schedule control; d- assessment). - Implementation (a- installation of new equipment; b- parallel operations; c- manuals amendment; d- schedule control; e- assessment). - Production (a- procedure manuals amendment; b- schedule control; c- maintenance plan; d- final documentation; e- assessment).

ANNEX III.

VENEZUELA

Cases	Step and Activities
1. Project initiation	- Specification of main information. - Objectives and contraints of the project Appointment of team to carry out the project.
2. Selection of system development personnel	- Selection of personnel to carry out project. - Recruitment of personnel.
3. Planning 3.1 Definition of System	- Prelimary design (general requirement, design of system as a whole). - Feasibility study (identify alternatives, realization of technical feasibility and cost/benefit - Feasibility report.
3.2 System Specification	- Detailed specification of objectives and environment. - Functional analysis (identification of functions, input-output; processes, additional data, definition of interfases, functioning of the system). - Allocation of functions to the elements of the system (hardware, software, data base, archives, etc.). - Identification of constraints (external environment, interphase, design and implementation, etc.). - Costs - Schedule.
4. Evaluation Project	- If system meets the objectives - if specifications meet the system requirements - if resources are well allocated - if implementation is justified.
5. Selection of Suppliers	
6. Evaluation of Suppliers.	
7. Preparation of contracts.	
8. Contracts evaluation	
9. Selection and Recruitment of personnel	
10. Reception and installation of equipment	
11. Implementation and test.	

ANNEX IV

THE ITERATIVE SYSTEMS DEVELOPMENT CYCLE (Rubin, 1986)

Phase	Step and Activity
1. Systems Planning	- Perception of need. (Clarify problem; identify need, and initiate study). - Develop information systems plan. (Relate information systems development to goals of the organization via conclusion of agency executives in planning process). - Feasibility analysis. (Carry out preliminary feasibility study to evaluate adequacy of existing system and determine economic feasibility).
2. Preliminary Systems Analysis	- Analyze existing system. (Determine strengths and weaknesses of existing system). - Determine information requirements. (Establish preliminary understanding of users' information needs and identify initial data entities and attributes). - Establish initial prototype specifications. (Generate specifications for initial prototype, including input, output, and processing components)
3. Preliminary Systems Design	- Design processing logic, inputs, outputs, and manual procedures for initial prototype. (Involve users as active participants in the design of input screen formats, output screens, reports, and manual and automated procedures). - Specify data base structure for initial prototype. (Design initial data base structure and specify preliminary data access mechanisms).
4. Initial Prototype Implementation	- Develop prototype programs and procedures. (Code prototype programs with a 4th generation language, and test/document prototype programs, specify initial instructions and manual procedures). - Construct prototype data base. (Use DBMS to establish and load initial data base with realistic data). - Deliver initial prototype and provide user training. (Make protype available to users with preliminary documentation and accompanying training seminars).

5. Prototyping Cycle	- Evaluation. (Users work with new prototype to detect deficiencies or needed enhancements and modifications; leave cycle if system is satisfactory and complete). - Analysis. (Systems analysis to develop next prototype, specify new requirements, modifications, and prototype enhancements based on users' experience). - Design. (Revise input and output formats, processing logic, data base structure, and manual procedures for new prototype). - Implementation. (Modify existing 4th generation language code; change documentation and manual procedures; construct or modify actual data base, and deliver new prototype to end users).
6. Operation and Maintenance	- Operate system. (Run the latest prototype as the production system). - Postaudit evaluation. (Periodically evaluate operational prototype to determine when prototyping cycle needs to be reinitiated).

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THE GENERAL CONCEPTION OF STANDARDIZATION OF CHINA'S STATE ECONOMIC INFORMATION SYSTEM

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ABSTRACT

System integrity is the fundamental guarantee that a large scale information system can play its normal functions, so a complete series of standards of information, technology, management and quality control must be set up at the very beginning of the construction of the information system. Based on experience and lessons at home and abroad we paid great attention to the standardization of the State Economic Information System (SEIS), and a thorough plan on standards was drafted up while the overall plan was being made. In March, 1986, "The Specifications on Standards of Design and Application of SEIS "[1] was worked out and ratified as a guiding document to the construction of SEIS by the State Planning Commission and the State Standards Bureau. The standards cover raw data gathering, information classification and coding, data record format, information processing in Chinese Character, data communication, computer networks and system interconnecting, databases, model banks and methods libraries, software engineering, system safety and security necessary documents, standards management of the system construction, etc. This paper puts its stress on the general conceptions of standards of SEIS on the basis of the specifications

1. INTRODUCTION

The standardization is an important means for organizing modern production and engineering construction, and a key part of scientific management. With the development of science and technology, and the progress of the times, the human society trends towards variety. On one hand, such a trend widens people's outlook, enriches people' s life; on the other hand, it leads to social complication. And such a trend of complication often brings out a great deal of ineffective and repeated work. If there are no proper limits and standards, the improvement of the social benefits must be deeply affected. The way to simplify is to pursue standards.

China's SEIS engineering is a giant technologies and funds intensive system engineering, composed of central level, provincial level (about 30 provincial centers), central city level (about 300 centers) and enterprise and county level (about 2100 county centers and 5,000 key enterprise centers), and also some branch systems of ministries and commissions under the State Council closely related with economic activities. The aims are to collect, process, store and analyze the information relative to economic activities inside China, provide information services and decision supports for economic activities. In order to realize these certain aims, every part of the system design, implementation and operation should be well coordinated. Therefore, it is very important to emphasize system integrity. Because of these features, the standardization problems in the design, development and application of the system are strategic problems which must not be ignored.

There are many cases at home and abroad of a lot of benefits because of emphasizing the standardization and of heavy failures because of ignoring this. For example, in order to stress the enterprise management, make unified reports and share the information resources, the French government organized groups of ten individuals, and they have put forward a preliminary unified plan about diverse information conceptions, vocabulary and the format of report forms after two years work. It was estimated that this work only of system standardization had already saved thirty thousand man/year of repeated work and expenses of six billion Francs and effectively enhanced the utilization of information. On the other hand, the U.S. Forest Bureau has built various information systems since the beginning of 1960s; however, the system resources can be hardly exchanged and shared because unified specifications and standards management are ignored. To keep the normal information exchanges and usage among such information systems with large investment, 400 thousand dollars extra have to be paid each year. Now they have to come back to rebuild the technical specifications and implement standardized management. Such positive and negative experiences are worth being referenced.

2. THE OBJECTIVES, SCOPES AND PRINCIPLES OF SEIS STANDARDS

There are two objectives of SEIS standards briefly:

1) Assurance Integrity and Making the System Scientific

The integrity of the system is emphasized just because it is the basic guarantee to achieve system resources sharing. A giant information system like SEIS involves wide economic and technical fields, such as the determination of economic indicator system, information classification and coding, raw data gathering, system interconnection, databases, software engineering, system safety and security, the administration of the system building, etc. So there are many conceded factors hindering system integrity. They must be coordinated through standards so that the system can as a whole make the most.

2) Investment Saving and Quality Assurance

Through standards the common usage of software and data products can be enhanced, to reduce repeated work, so that the investment of system development and maintenance can be saved.

As to the construction and application of the system, the standards management, system test and examination standard should also be conducted to assure the quality of system building.

According to the objectives of SEIS standards, the scope of SEIS standards can be fixed: any item that has multiple choices and hinders system integrity or increases system investment owing to different choices must be standardized.

In detail, the SEIS standards can be classified as four categories;

1) information standards, including economic indicator system, information classification and coding, document formats, terms, raw data gathering, quality control, etc.

2) Technical standardization, involving information exchange format, data in Chinese character processing, data communication, computer network, system interconnection, data base, model bank method library, software engineering, system security, etc.

3) Management standards, include the management methods of the design and implementation of SEIS, various rules and regulations during SEIS operations.

4) The standards of quality control, include the perfection of diverse quality standards such as raw data collecting, software products testing and series of standardized tests and examinations setting-up.

In order to coordinate and organize SEIS standardization work a set of principles are fixed as follows:

1) Higher level standards must be adopted. Each level of the system must actively adopt the standards ratified by the higher level involved in it. It can not make another one. As to the national standards, the whole system must adopt. Furthermore, according to the state standardization policy -- "vigorous adoption of international standards", international standards can be adopted as equivalence when no national standards.

2) The co-operation principles. The goal of standardization is not only to set standards, the most important thing is to pursue the standards in a certain range. Therefore the standards must be pursued through the co-operation among all concerned. The standards must be drawn up on the basis of the scientific experiments, biggest system benefits and relative identical views.

SEIS standards should also be made through co-operation with State Standards Bureau, every industrial management department, all the comprehensive economic management departments and some units outside the system. Only in this way, can we catch up to the demands for standards from the system construction at present when the information techniques develop rapidly.

3) Facing future principle. If a standard is determined, it will be executed as a rule. So it must keep relatively stable, and it is required that when the standard is drafted we must be clear of the trends of the development of sciences and technologies and seize the opportunity, thus the standards can concord with the scientific and technological developments.

By this principle, it is requested to seize the proper opportunity to set standards. The development of new technologies can be divided into three phases: (1) Sprouting phase. In this phase, the problem is just put out. The development is somewhat slow. (2) Developing phase. At this phase the theory is formed, a lot of experiments and improvements are being made. It is developing rapidly. (3) Ripe phase. Now the theory is already fixed and comes into use. SEIS standards must begin near or at the end of the developing phase.

3. SPECIFIC TECHNICAL POLICIES OF SEIS STANDARDS

3.1 Raw Information Collection and Quality Control

The standards on this aspect aim at the improvement of raw information quality and reduction of the repeated data collection. Experience shows that an unreasonable indicator system would bring astonishing wastes because of repeated raw information collection. The following aspects of work will be stressed in the SEIS construction.

1) Standardized indicator system. For historical reasons, there are several economic indicator systems in China. There are often different interpretations to one term, so they lack of exchangeability. Such cases makes the information collection and utilization more difficult. Now the problem is emphasized by the State Council and a specific group is formed to manage the work.

2) Set a perfect indicator dictionary. The indicator dictionary is a manual which covers and defines every indicator's meaning, calculation methods, measure units and the interpretation of the indicator. It is an important tool to guide information collection and application. Its completeness and availability must be ensured.

3) The organization work of raw data collection. It involves organizing information sources, information distribution and, the rules for data collection, the collecting procedures etc. Now the economic system reforms are being conducted in China, whose aim is to add the marketing mechanism to the unitary planned economic system and enhance the economic vitality. So it is necessary to gather information through markets besides through existing administration channels. Only in such ways can the economic situation be seen clearly, accurately and in time.

4) Data entry. Centered on the data entry, data material management, magnetic media management, worksite management, quality standards of data entry, etc. must be well done.

3.2 Information Classification and Coding

To classify information is to systematize the information for easy usage. The information coding is to show the information classification and make it easy for computers to store, process and transfer. such work is quite a lot. Our policy is that an unified technical system of information classification and coding should be set up based on full study of the theory and then all forces of the whole society will be organized to do the work under the direction of the technical system.

3.3 Information Record Format and General Document Format

This is mainly directed to information exchange. Now the standardization degree of the information record formats on the tapes, paper tapes, cards and some other media is quite high. The information can basically be exchangeable, but it is not enough. The standards at higher level should be achieved. That is to standardize the format of documents and reports, so that information exchanges can be conducted better. There is now a special group doing this work in China.

3.4 Information Processing in Chinese Character (Hanzi)

Hanzi is the unique wording commonly used in China. Therefore Hanzi Information processing plays a key role in the effective operation of the SEIS. Now the study on Hanzi information processing is being developed vigorously, the favorable opportunity should be seized to do the standardization work. This work includes Hanzi codes, Hanzi input and output, Chinese words sets, etc.

3.5 Data Communication, Computer Network and System Interconnection

In 1981, the International Standardization Organization (ISO) formally put out an international standards of "a basic reference model for OSI (Open System Interconnection)". It has already been accepted by several large international standardization organizations, such as CCITT, IEC, ECMA, etc. It is widely recognized as the architecture of the new generation of networks and also the standards of the network building. Many big computer manufacturers have already declared their support of OSI one after another. This is one of the development trends of information techniques. With regard to data communication, computer network and system interconnection, in SEIS, the strategies are as follows: the master architecture is in accord with the ISO's OSI system architecture. At the lower three layers i.e. data communication part, the V series and X series of CCITT and part of corresponding ISO standards are adopted while at the high level protocol, the ISO stands and part of corresponding CCITT standards are adopted. This strategy is identical with China's standardization policy.

3.6 Data Base, Model Bank and Method Library

These three bases are the kernel of SEIS. So their relative standards must also be paid enough attention to. Now, ISO's work about data bases centers on the network data base language, relation data base language and the data base dictionary system. Some improvements have been achieved. Digestion and transplantation of international standards are being conducted in China. As to the model bank and method library, the study is in the sprouting phase, so there are no conditions for doing their standards yet. Attention to tracking the development of these techniques should be paid. When time is ripe, the work will begin.

3.7 Software Engineering

Software engineering includes the specifications of software development, software products document specifications, software quality guarantee specifications, software disposal management specifications, etc. Some technical people have been organized by the State Standards Bureau to make corresponding standards. During SEIS building, the national standards of software engineering should be executed to assure the quality of software products.

3.8 System Security

The standards of data encipherment algorithm, key management and diverse security quota, etc. are all included. Now ISO recommended a data encipherment algorithm as an international standard. With adoption of international standards, and in the domestic demands, profound study of data security is being conducted and the security standards are being regulated in China.

3.9 Management Standardization.

To make the most from the investments, the system construction of a huge system project like SEIS, must be aimed at the whole life cycle of the system and must be strictly conducted in accordance with the methods and steps of system engineering. A series of management standards must be regulated and management should be standardized. The standards of management mainly include:

1) Documents

Indispensable for the system construction. They are the documents which should be submitted to the superior management department by the person in charge of system construction during the system building. The superior management department examines the system building plan, inspects the progress of the system building and supervises the organizer of the system building to do the work according to the scientific and standardized methods and steps.

2) Standards Related to Rules and Working Procedures.

For example, the demonstration and approval procedures should be made for Large-sized computer system purchases. The procedures of standardization have to be standardized too. The standards of the standard plan drawing, standardized procedures, standardized revision, procedure and the standardized review procedure must be drawn up.

3) The Rules for the Standardized Rests.

The work of SEIS fixed standards should also be pursued and the new standards must be regulated. The rules for the standardized tests have to be set up to test new software and equipment of the system. Thus the unstandardized software and equipment can be prohibited from entering the system and affecting the system standardization work.

4. THE GUARANTEE FOR STANDARDS IMPLEMENTATION.

4.1 The Guarantee in Organization

A specific organization in SEIC was established to organize and coordinate to make standards in the system building.

4.2 The Guarantee in Rules

The rules for standards inspection must be set up. When the related report is examined, its standards problems must be resolved. If the design does not correspond to the standards, it will get no approval. The software, equipment and information system unconformable to the standards will not be adopted by SEIS in principle.

4.3 The Guarantee in Investments

The investment needed by the SEIS building is collected by the Central and the local authorities. The design unconformable to the standards has no guarantee of the investment form the central authority.

4.4 Regulating "The Specifications of Standards of Design and Application of SEIS"

The specifications fully reflect the demands of the standardization of the SEIS. It is a technical manual, which guides the SEIS engineering to develop soundly and smoothly.

Reference

1. The Specifications of Standards of Development and Application of SEIS (in Chinese)

THE NIMS METHODOLOGY FOR BUILDING AN OVERALL INFORMATION STRUCTURE IN SWEDISH LOCAL AUTHORITIES

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(*) This paper was originally scheduled as a working group background paper. However, Mr. Salomonsson kindly accepted to present it at this plenary session.

INTRODUCTION

The introduction and use of computerised information systems in Swedish local authorities has faced problems familiar to those of similar organisations in most countries of the world. Sweden was one of the first countries to introduce computerised systems for local administration and planning. This has had two effects. First, the pioneering nature of these developments led to a rather simple information structure, or rather no structure at all. Second, because information systems have been around for such a long time, some have been replaced with more modern ones, some have been abandoned, many have been introduced in areas previously not computerised and many systems still in use have been successively changed, amended and patched up such that they are becoming very hard and expensive to maintain.

The average Swedish local authority uses several systems. These systems run on different computers using different operating systems, different data-base handling systems and different protocols for communications. Many of the local authorities have spent considerable sums of money in order to achieve physical integration between these systems by introducing dedicated communication computers, digital telephone switchboard systems for data and voice communication, etc.

The rather discouraging results of these investments are now being discovered by the local authorities in the technical front-line. Operation of their systems probably allows communication from a technical point of view. When it comes to actual exchange of information between systems, however, the main problems of incompatibility turn out to be of a non-technical nature.

What has so far been largely ignored is the fact that integration and functional communication between systems require a common structural basis. Systems that do not use the same set of definitions and standards will never be able to communicate in an efficient way.

It would be interesting to find out how this situation has arisen. One would assume that people who learned not to add apples and pears in primary school would not try to do so later in life by using a computer. It seems to me that considerable faith is attached to the application of technical solutions to logical and methodological problems.

The truth is that attempts to solve logical inconsistency by technical means are more likely to increase the inefficiency and inaccuracy within the information handling of an organisation.

Another interesting observation is that technical, and to some extent methodological, development is far ahead of the organisational development of information handling in Swedish local authorities. For example, modern techniques of on-line data-base handling readily enable the sharing of common data within the organisation. Several applications can use the same basic data items and update them in a common data base. This structure saves not only storage but also ensures that every user works with the very latest information.

In Swedish local authorities, however, the dominant structural and technical concept is that basic files for common information (on individuals, properties, etc.) be kept and updated in such a way that the various departments can fetch and update their own registers at various intervals. This leads to duplication, the risk of inconsistency between files and lower quality information.

The NIMS Project

In 1971 the Scandinavian Ministry Council funded a project at NORDPLAN, Stockholm, aiming at the development of computer-aided planning methods. This project resulted in the NIMS planning system, which is well documented.

The results of the project were very promising from the planning point of view and the various models and planning tools developed were spread to local authorities in all Scandinavian countries.

It was, however, discovered very early that computer-aided planning systems face some very critical problems, the most important of which relate to the acquisition of relevant input data for the systems. Two main problems within this area were identified. First, the planners had neither the financial nor the manpower resources to update and maintain the data-bases needed. The data-bases should therefore meet the needs of other users, i.e., for administration.

Second, even if the resources had been available, the data kept within the local administration could not have been stored in a computerised system without a lot of restructuring. For example, it was found that in the one local authority, 13 different definitions of the property concept were used simultaneously.

As part of the NIMS project a study was carried out in order to get an overall picture of the total information handling within the Swedish local authorities. The study aimed to provide a background for the establishment of a basic information structure that would allow planners to extract and use data from the administrative procedures for planning purposes. This was quickly found to be impossible - the absence of structured information was even more serious a problem for the introduction of computer-aided systems in administration than it was in planning. The study was therefore enlarged to the creation of an overall information structure for all the information handling within the local authorities.

Methodology of the study of information handling in local authorities

The study has three main parts. These were :

1. A study of existing information-handling functions

2. An evaluation of possible improvements by introducing computerised information-handling techniques and new methods based on such techniques; and

3. The creation of an overall information structure allowing the information stored in the local authority to be used as a common interdepartmental resource.

In order to carry out the first part of the study, it was decided to focus on day-to-day information-handling operations, i.e. operations used within the daily routines of a department. These operations can be separated from the analytical operations with which the activities of the department are planned. The latter were excluded because the information needed for analytical operations is generally created within the day-to-day operations.

Information handling in a typical Swedish local authority was divided into 22 main application areas such as child-care, water and electricity supply, refuse collection, maintenance of public buildings, etc. Each of these was further subdivided into activity areas such as billing of water rates, allocation of children to primary schools, etc.

Finally, the division into operations was carried out in such a way that each operation was uniquely and easily defined and that the operations were clearly separated from each other. Examples of such operations are the actual registration of a building-permit application, the assignment of a child to a specific day nursery, etc. The subdivision of information handling as described above resulted in about 4,000 specified operations within a typical Swedish local authority.

It should be emphasised that this subdivision seeks to find a suitable way to handle the analysis of the information handling; it is not an elaborate scientific method of division. Equal or even better results could probably have been obtained if other, finer or more coarse divisions had been applied.

Each of the 4,000 operations was submitted to analysis in which the following items were identified :

a) information required initially, i.e. to start the information handling activity

b) information collected during the activity itself

c) information processing during the activity, analysed according to the following processes:

- identification processes, i.e. processes in which existing object types and terms are defined. This will result in a basis for the construction of a data dictionary for the whole information-handling process within the local authority

- classification processes - when classifications rather than discrete data values are used, classification schemes should be identified, especially when the same data items are used in different schemes;

- aggegration processes, i.e. the requirements within the activity of data aggregation

- relational processes, i.e. how object types are related to each other in the activity. For example, the relationship of an individual in the case of the registration of a building-permit to other objects: as applicant (in the application dossier), as owner (of the property) or as technically responsible for the construction work;

- time processes, i.e. how the spatial dimension is handled in the activity, for example as spatial aggregation or processing of co-ordinates in geodetic activities.

d) methods of deciding which information resulting from the activity should be stored and which should be destroyed; and

e) methods of storing the information about the activity so that it can be retrieved as input for another activity.

The analysis described above took much time and effort. As quite a few of the 4,000 operations were rather similar, they could be grouped and analysed together. The analysis resulted in a rather detailed knowledge of how the information handling was carried out in a typical Swedish local authority where use of computers was still limited.

When the study was carried out, computers in local authorities were mainly used for accounting and billing.The study revealed that the introduction of computers for these purposes had not lead to any effort to structure the information to create a common information resource in the municipalities. There were still 13 different definitions of the property. In most cases the introduction of computer technology had only meant computerisation of the former manual methods for information handling. There had been no attempt whatsoever to take a comprehensive approach to the problem of information handling in the local authorities.

It would be fair to say that during the 12 years since this study started, very little has been done in this direction outside the NIMS project. The introduction of new computer systems has continued to accelerate, however, resulting in the rather chaotic situation mentioned above. The introduction of the PC has further accelerated this situation.

The NIMS study examined the ways in which information handling in the local authorities was carried out manually. Knowledge of these methods was certainly not a sufficient basis for the construction of integrated application systems in which the computer technology is taken advantage of. The introduction of the technology is meant to add new possibilities to the way the information handling can be carried out, e.g. it should also serve as a new frame of reference for the introduction of new information-handling methods.

This requires knowledge, not only of current methods of information handling (as encountered by the study) but also a knowledge of the technology, or rather the ways in which it can be applied to the various oprations identified, how some of these operations can be replaced with more efficient ones and how some of them can be removed.

Many local authorities have encouraged their departments to produce specifications of the systems they would like to acquire. This turns out to be a rather impossible task. It requires that the department describe in detail how a technology, of which they have no previous experience, should be used in their daily activities. The lack of experience nearly always results in a specification in which the methods of the existing manual sysem are computerized with only very few modifications. The worst possible outcome of such an exercise would probably be the situation in which the department gets the system it has described. It is only after a system has been used for some time (at least six months) that people will be able to realise how the technology could be applied within their own field.

To get around this problem, the 4,000 identified operations were analysed against an evaluation of the information handling processes listed above. It was assumed that computer technology and its various components were available and that the information necessary to carry out these operations was available in a structured information resource common to all departments.

Each operation was described as it would be ideally carried out under these new circumstances. At the same time consideration was given as to whether the operation was still necessary, whether it could be replaced by a more efficient one, or whether the methodological context in which it was carried out could be substituted by a different and more relevant information-handling method. The resulting scenario, showing how local information handling was adapted to the use of computer technology, was expected to provide a more relevant basis for work on the construction of a suitable information structure for the local authorities.

Based on this knowledge two interdependent analyses were performed. The first concentrated on how object types and their interrelations were identified within each application area, the data dictionaries necessary and the demands on the data structure. The study was made by grouping all operations belonging to the same application and trying to optimize the structure to suit this particular application.

The second analysis was carried out by concentrating on the demands set out by the first analysis concerning each object type. This analysis resulted in a framework for how to build the common registers for each of these object types, i.e., individuals, properties, enterprises, pipeline or street segments, etc. The most important knowledge obtained from the first analysis was the identification of the ways in which these registeres were functionally independent and the requirements this placed on the design of the registers and their contents.

On the basis of the above two analyses an overall information structure for computerised local authority information-handling systems was established. The structure in itself is merely a set of rules. It gives all the necessary instructions for which minimum requirements a new application should meet in order to fit into the framework of the common information resource. It states how information about the various object types should be stored, interrelated and accessed. By eliminating wasteful duplication it minimises data storage, maintenance and updating and ensures that data are consistent between applications. One result is that names and addresses of property owners will not be stored in the property register. Instead only their identifiers are stored, linking to the register of individuals where their addresses are updated from the civic registration files. Consequently, if an owner moves from one address to another, the property file is not affected. In the structure some 30 applications will fetch the addresses from the file of individuals when needed.

Design and implementation of applications within the NIMS concept

Once the overall information structure is established, applications can be specified. The specifications of the operations can be made regardless of how the structure is built up, but the design of the application system itself concerning data dictionary, definition, standards and relationships must follow the rules and constraints given.

This has so far been the most critical point in the computerisation of Swedish local authorities. The most common way of introducing application systems has been the one in which each department, independent of others, has produced specifications for the desired applications. These specifications have generally been worked out within the departments and have introduced new definitions and standards for objects already existing in applications in other departments. The co-ordinating agencies in the local authorities have not had enough resources to direct and control this development. The result has been an inefficient and diversified data and information structure.

The local authorities that have adopted the NIMS information structure have achieved a common accepted information structure in which all new applications can benefit from existing registers, files and functions. Updating of most common information is done outside the department and data are only stored once within the system. Simultaneously, a common information resource, available to all authorized users, is created and maintained.

ISSUES ASSOCIATED WITH THE TRANSITION FROM A PLANNED TO A MARKET-BASED INFORMATION SYSTEM

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INTRODUCTION

The focus of this paper is the development of information systems and their use in gaining economic efficiency. The context is the International Conference on "Strategies and Methodologies for the Design and Implementation of Information Systems in Public Administration, with Special Emphasis on Economic Information Systems."

While this conference is broadly focused on the optimal design and implementation of information systems to enhance the efficiency and productivity of government, this paper will focus on one particular aspect of the problem: the difficulties associated with moving from a planned economic system to an economic system which contains aspects of both planned and market-based economies.

The purpose of the paper is to develop some generalizations concerning the characteristics of decision-making procedures and how the use of information systems interacts with economic activities. Some of the contrasts between planned and market-based decision making by governmental economic organizations will be identified. An emphasis will be placed on areas which directly affect the design and development of information systems.

1. PLANNED VS MARKET-BASED DECISION SYSTEMS

In the evolution of economic history, widely differing economic policy making and control systems have been devised. These systems evolved on the shoulders of economic history, and they have evolved in concert with the development of cultural and political patterns within individual countries and within specific and different social systems. Consequently, it is difficult to accurately characterize information systems without reference to the particular activities and cultural evolution of the specific nation being considered. Nevertheless, there are two generic classes of social and economic systems which have been adapted in varying degrees during the late 20th century.

These two broad systems are frequently characterized as "market-based" economies and "centrally planned" economies. Many countries, especially the newly developing nations, have a mixture of these two generic forms of economic organization. In other cases, economies that are currently characterized as centrally planned are experimenting with developing supplemental or complementary sub-systems that are market based. And likewise, countries that are traditionally labeled market-based economies are seeking improved methods for central or national control of key economic functions that are important to the achievement of social, political, and economic goals.

For centrally planned systems the most representative system is the Soviet-type system which attempts to regulate directly, comprehensively, and in highly aggregated detail almost all spheres of macro- and microeconomic activity. The economic goal in such an economy is "plan consistency."

In this system, the state seeks not only to plan, but also to enforce centrally determined decisions through mandatory administrative directives.

The informational requirements of such a system have historically proven to be impossible to meet. Literally millions of balancing equations and variables need to be solved to ensure that this central plan meets the economic efficiency criteria of its planners. This perhaps is one key reason why the current Soviet leadership is embarking on "perestroika." Perestroika involves an economic restructuring within the Soviet Union which introduces limited freedom for managers and individuals to make market-based decisions. But this mixture of the two systems provides some difficulties. For example, operating outside of the state planned network is risky since obtaining access to extra inputs and materials may be more difficult than getting extra customers who want goods outside the planned system. Likewise, "self-financing" of production outside the system may not mean much so long as prices are set by the central planners and the official prices bear little relationship to real costs. Difficulties also face the planners since the distortions in the system will make it hard to put real pressure on losing production units. The managers of the loss generating units will have a wide range of reasons for their failure, and they will be inclined to ask for special treatment.

Plan consistency is only one side of the coin. It does not necessarily or automatically lead to optimality, or even efficiency, in the use of resources. Difficulties with allocation of scarce resources become immediately evident because of this structural impossibility of meeting these huge information requirements. The thrust of perestroika is to decentralize decision making in order to reduce informational needs. This, in turn, changes the nature and type of economic signals and information required to attain allocative efficiency.

Thus, the problems of shifting decision making from a planned system to one containing elements of market-based economies introduce some interesting implications for centrally a planned information system because information developed by the central authorities as the basis for public policy decisions must then take into account market-developed information which may be created or designed to meet other goals. In order to characterize the nature of the information systems in these two contrasting models, it is helpful to first characterize the decision process in each simplified model.

2. CENTRALLY PLANNED SYSTEM MODEL

The concept of a centrally planned economy involves basic decisions concerning what will be produced, and where and how it will be produced. The central authority determines priorities among competing activities. The resource allocation processes involving distribution, pricing, and total supply of all goods must also be simultaneously determined by this central authority. For example, basic commodities such as foodstuffs and infrastructure requirements such as transportation, utilities, and the level of final product output are all determined simultaneously using a national plan. But the distinguishing feature of such a system, as typified by Soviet-type planning, is that these centrally-determined decisions are implemented through a system of commands or mandatory targets; hence, the term "command planning." This system's shortfall is that it lacks the flexibility of feedback or revision procedures where impediments exist in meeting these targets.

In addition to deciding what to produce, the central authority has to decide on how to produce. The question of how poses two problems. The first is to ensure that the desired production program is feasible, i.e., that sufficient resources are available given existing technology. This is the central problem of plan consistency: to ensure that resources match requirements.

But even if a consistent or feasible plan is formulated, such a plan may not be an optimal one. In economic theory we know that a number of equilibria, or technically feasible solutions, might be available, but there can only be one optimum. This is the second problem: the problem of achieving optimality or allocative efficiency.

This second problem is exacerbated if one adds an external sector for consideration. Economic comparative advantage theories state that a country should exploit its natural and productive resources in such a way that it can trade a surplus of goods with other countries who are similarly operating efficiently. In this way, through trade, both trading partners can improve their standard of living. However, to conduct successful trading activities, one needs the same information possessed by one's potential trading partners. Because of the information limitations of a centrally planned economy, it cannot take full advantage of the benefits of international trade.

Since the economic system is comprised of so many transactions and interactions, it is necessary for the central planning authority to adopt simplified models of the total flow of economic interactions. In a highly structured approach, the planning ministry adopts an elaborate input/output description of key economic interrelationships. In Soviet-type centrally planned systems, plan consistency is achieved through what is known as "material balances," or tables which set available resources against plan requirements.

This materials balance method, however, does not ensure allocative efficiency. Moreover, the constraints involved in collecting, processing, and transmitting information on every economic market condition, and the physical impossibility of solving a system of simultaneous equations involving millions of variables, imply that data has to be highly aggregated. The degree of detail with which central authorities formulate plans is therefore constrained by the efficiency of this abbreviated information system. An absence of complete or adequate information at the decision-making level requires the delegation of some decision-making powers to lower-level managers who also oversee the actual execution of the central plan.
Given the complexity of economic decision making, it follows that the decision-making process must be a multi-layered bureaucratic process. Broad goals are determined centrally while proposals for the achievement of those goals are developed at subordinate ministries, who in turn draw upon regional authorities and key production establishments for their technical expertise.

The information requirements of this process are formidable. Consider, for example, the simple case of determining targets for agricultural production. A planned level for grain production requires an analysis of the total needs of the society for various grains. This involves estimating nutritional requirements and an assessment of the specific production capabilities of various farm enterprise units.

At the beginning of the planning process, one must determine expected weather conditions, evaluate the ability of the farming units to harvest on time, and arrange for transportation and storage of the output. Many details such as the amount of spoilage or waste that can be expected must be also evaluated. Most importantly, decisions must be made to assist the distribution/allocation process to ensure the output is equitably used.

Since the yield of an agricultural unit can be enhanced by the introduction of modern machinery and special techniques such as the use of fertilizers, the decisions concerning agricultural production must necessarily include analysis of petrochemical output which will be devoted towards the production of fertilizers, analysis of machinery output which will be devoted to the agricultural sector, etc. The value (or benefits) of the agricultural inputs must be compared to the value (or benefits) of using these inputs in other industries. In this manner, decisions concerning one sector necessarily affect every other sector. The costs of producing this output must also be tangibly determined in order to decide whether it is even feasible to grow this crop internally versus importing it.

These decisions are only the beginning of a comprehensive planning process. Other decisions that must be made include allocating a specific amount of land for agricultural use versus other uses such as housing. Future investments which could enhance agricultural yields at the expense of other industries must also be considered, a choice which is difficult to make without comparable external data - a point made above.

In the centrally planned situation it is essential to have detailed information concerning past practices and performance as well as future demands. In an ideal centrally planned economy, the central ministry receives current reports on output and is able to analyze the actual situation compared with plan targets so that areas of shortages or surpluses can be adjusted to keep the total system in balance. The central ministry should have an accurate gauge of what output levels would be under various resource allocation schemes. The ministry should also be aware of alternative methods of production in order to be able to substitute resources most efficiently.

In practice, of course, information on difficulties is sometimes suppressed or even exaggerated so that the local manager will not be criticized for failing to meet targets. At times there is the hope that the shortfall in a current production can be made up in the future. Likewise, there is a natural tendency for production ministries to achieve a surplus as a cushion for future difficulties. Unfortunately, these unreported imbalances can distort the ability of the total system to operate efficiently. Consequently, there is a premium on obtaining accurate and current information on production achievement in relation to the planned economy's goal.

From the point of view of the supervisor of the individual production unit, the centrally planned system offers several difficulties. First, the manager is faced with limited autonomy because production targets are externally determined. Decisions concerning the distribution of output are largely predetermined, and opportunities for investment in new plants, obtaining critical resources such as fertilizer and machinery, and other dimensions of the management process are externally constrained. In the pure model there is an absence of the bilateral relationships between enterprises supplying and buying each others' output. In other words, choices are severely limited by the dictates of the planned interactions in the economic system.

Perhaps the biggest information problem that central planners face is the lack of integration of information across industries. Assuming that accurate production and resource information is exchanged between the planners and producers (a vertical information exchange), there is little opportunity for producers of separate products to join forces to improve each others' productivity (a horizontal information exchange). The result is that innovation and productivity growth may be stifled.

2.1. The Statistical Apparatus in a Centrally Planned System

As indicated in the earlier discussion, it is clear that the centrally planned economic system requires an extraordinary amount of detailed historical and contemporaneous information concerning actual production levels as well as projected requirements. Thus, in an important sense *the statistical reporting system becomes a precondition for the development and implementation of the master plan for the economy.* The collection of timely key statistics is essential in order to permit the central authorities to correct for imbalances which may arise during the implementation of this central plan.

In the idealized model, each enterprise reports to its local authority which in turn reports to regional authorities which in turn report to either super-regions or to the central authority. With the advent of improved telecommunications and modern computers it is now possible, in theory, to collate information quickly, to analyze actual production results, and to measure inventory levels. Furthermore, the information collection can be designed as a total census since all reporting units must submit reports and the result, ideally, would be an accurate representation of actual economic conditions.

In practice, however, the idealized model is not always reached. As noted above, some reports may be inaccurate or misleading. Besides these sources of reporting errors, other errors may arise from problems associated with interpretation of definitions and concepts, lack of sophisticated audit capabilities, and failure to note defects or quality deficiencies.

3. THE MARKET-BASED SYSTEM MODEL

In the market-based system, the broad targets for economic growth and activity are established by the individual enterprises based upon their own assessments of opportunities and individual capabilities.

In the pure market-based economy, the economic agents themselves control the allocation of scarce resources. Individual enterprises take risks when they initiate production for which there is a perceived demand, and the individual enterprise succeeds or fails based on its ability to: 1) identify the demand; 2) satisfy the demand; and 3) undertake the process in a manner that generates a surplus (or "profit") as a reward for undertaking this endeavor in the first place.

In a market-based economy there is little need for macro decisions. Macroeconomic policy consists primarily of the collection of revenue to meet basic governmental functions such as defense, police protection, or justice systems, for example, and regulation of the money supply. In the pure market-based society model, basic services such as education, medical services, power utilities, transportation, banking, and other functions are provided on the basis of risk-taking by individual enterprises, just like any other commodity. The macroeconomic role of government is merely to ensure that these markets operate efficiently and fairly. Thus some regulatory activity is established.

In some instances, the markets may fail to provide goods or services in a manner which enhances the efficiency of the entire economy. In these cases, most open-market societies have determined that the broader responsibilities of government include providing basic infrastructure activities such as highways, bridges, or energy, as resources which expedite the production of other goods and services. Industrial organizations also need to be shaped by the government where free markets cannot provide a good efficiently or in the public interest. Regulated monopolies may be formed as a result.

3.1. Microeconomic Decision Making in the Market-Based Economy

The decision makers in a market-based economy are the individual entrepreneurs rather than a central authority. Individually, these entrepreneurs assess market needs and production costs for all goods and services sold in the marketplace. Detailed market information is absolutely required for these endeavors and is readily obtained through the aggregation of the entrepreneurs' activities. If the entrepreneur correctly assesses market and cost conditions, the reward is shown in profits. If incorrect assessments are made, the entrepreneur is out of business, losing investments and other resources.

In a primitive economic situation, the individual entrepreneur relies on powers of observation to determine marketplace needs. In more developed, complex societies it becomes difficult for the individual entrepreneur to detect market needs that are not being fulfilled by others, and to evaluate the prices that potential users would be willing to pay. In today's global economy, entrepreneurs are even free to turn to the external sector to gain price advantages over domestic competitors.

A key characteristic of the market economy is that objectives are established on a decentralized or local basis, and the accomplishment of these objectives is evaluated in terms of market performance. Prices, for example, develop in relation to the value of the product or service to the user, independent of the cost of production. If, for example, the price of a good or service is excessively higher than the cost of production, this high profit margin creates an incentive for other producers to begin to serve that marketplace. Over time resulting price competition reduces the profit margin to a point where further entry by additional firms is discouraged. The price of input resources is determined by the competitive bidding of the output-providers, who must estimate the usefulness of their product, i.e., the price, to the general market.

Conversely, if the cost of production exceeds what users are willing to pay, the business discontinues operations because it is unprofitable. Thus the enterprise's assets are then reallocated to some other use. A key characteristic of this process is that the marketplace ultimately determines the priorities (costs and benefits) that determine the patterns of production.

3.2. Statistics in a Market-System Model

Consequently, in most market-based economies there is an extensive information system containing data about prices, demands, and enterprise activity. Most nations have developed statistical systems to describe aggregate conditions in their economies. These market economy statistical systems use surveys, administrative records, and other sources which provide background information to individual entrepreneurs that wish to start, evaluate, or redirect their existing enterprises. Furthermore, in developed economies a number of entrepreneurs have taken on responsibility for developing general information for sale to other entrepreneurs as part of their market assessment activities.

For example, a number of companies collect information about individuals and businesses and use this information to create mailing lists for entrepreneurs searching for potential customers. Information on the financial status of the potential buyers allows users to determine their ability to pay on extended credit. Customers also seek information about the goods and services that are available from these vendors. Prices for market-driven information allow the markets to work as efficiently as possible and the availability of information provides opportunities for entrepreneurs to compete as effectively as possible.

Thus, two separate types of information are required in an open-market society: information on aggregate economic data, and information on firms and individual market conditions. The first type of data is generally provided by governments because of the complexity of the data collection process and the importance of producing such data in a highly accurate and timely manner. Firm or industry level data can be provided privately because it can be developed in direct response to entrepreneurs' or customers' needs. Thus, the provision of basic statistics in a market-system model is a dual responsibility of both the government and the private sector.

4. REQUIREMENTS FOR TRANSITION FROM A PLANNED ECONOMY TO A MARKET ECONOMY

As stated previously, there are no pure market-based economic systems. In all societies the government determines that some social priorities may not be properly satisfied by the open market. Consequently, the central government reallocates resources to meet demands which are not being met to the government's satisfaction. Tax incentives, expenditure programs, and governmental pricing policies are the tools used to implement these social goals.

Most countries have a mixture of planned economic activities and market-oriented activities. The Soviet Union and China have recently embarked on government sanctioned introduction of market-driven sectors in recognition of the fact that such an approach provides incentives for higher productivity and greater responsiveness to consumer demand. Since these efforts are designed to move a portion of total economic activity into a market-driven orientation, they are noteworthy. However, the coexistence of market-driven activities in a fundamentally planned economy brings to the fore the information policy difficulties outlined above.

For any economic system, the more activities that are deemed state responsibilities by the government, the more complex the macroeconomic decision- making procedures become. The commonality between both types of economic organizations is the need for a centralized information bank from which decision makers can draw. Given that any economy is really a hybrid of free market and centrally planned concepts, coordination of information generation and usage is essential.

The likely resolution of this dilemma is to introduce certain monitoring activities, at least on a sample basis, to provide the information needed by the planning authorities so they can understand the market-driven sector. From the point of view of the individual entrepreneur, however, care must be taken to assure that these reporting requirements do not introduce excessive intrusion into the risk-taking decision making nor do they introduce excessive costs that interfere with the market process. Once a repository for economic information is established, it is necessary to create an economic system which is tolerant of this dual planned/market economy. We shall use the allocation of credit as an example of how this merged system might work. This is done because credit allocation, taken broadly, is essentially the allocation of available resources to meet governmental or market-driven goals, and because the allocation of credit is a state function in a planned economy, and is done privately in a open-market society.

If a market sector is to be created with incentives to take risks and to offer rewards for successful risk-taking, it is essential to separate risk-taking credit allocation from the state process of resource allocation. In a market-driven sector, the private banking community evaluates specific proposals of individual entrepreneurs and assesses a premium (interest rate) based on the degree of risk involved. Implicitly, this risk assessment is based on alternative uses of the available capital. Entrepreneurs ration this capital among themselves depending on who bids the most for it. Naturally, the entrepreneurs who expect the largest rates of return on their projects will bid the highest.

In this manner, one enterprise competes against all others for available financial resources. If a state controlled bank allocates credit to individual entrepreneurs, the risk assessment is still subject to the aggregate demand estimates and the data deficiencies of the central planners. In this case, there is no true, efficient allocation process, unless the state information system is both accurate and complete. In a complex society the state cannot achieve this perfection. In an open-market economy, if the individual entrepreneur fails, his assets are reallocated into what hopefully will be a more worthwhile venture. In a planned setting, it is not clear that such reallocation schemes exist, and little incentive is provided for accurately evaluating risk and carrying out one's plans as promised.

In order to have an effective "market-driven" sector it is essential to have the supporting infrastructure for investment, and profit and loss evaluation. Creating this system without eroding the authority of the central planners is a difficult, but important challenge. Furthermore, it introduces substantial difficulties in designing a public administrative information system, which must provide the basis for the decisions of state planners. The failure of an endeavor may be regarded by planners as a failure of the central plan. As a result, the state decision makers may be reluctant to abandon a particular project, but the market sector should be free to fail.

WORKING GROUP REPORTS

WORKING GROUP A

METHODOLOGIES FOR PLANNING, DESIGN, IMPLEMENTATION AND MAINTENANCE OF INFORMATION SYSTEMS

Chaired by:
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WORKING GROUP A REPORT

INTRODUCTION

"Economic information system policies and strategies for public administration must be structured within the parameters of a nation's current and forseeable economic, social cultural informational and political contexts. They must also be derived from the objectives of national economic policy." (Paul Oquist)

"Information is a resource and a very powerful resource. Its wide-spread diffusion within an organisation or a society carries a great many beneficial effects. In developing countries concentration of information in bureaucratic hands has led to monopolistic control and computerisation, with deeply beneficial effects in the society. For better service of societal interests, it is essential that the governments should take a leading role in the diffusion of information and the related technologies, using its own agencies and should adopt realistic attitudes to overcome constraints arising from cultural, historical, economic and political issues. However information systems developed with the application of modern computer systems also lead to concentration of information in state data bases and if kept out of public scrutiny, may reinforce the bureaucratic and technocratic power of the administration. The right of access to information with some safeguards, thus, assumes a priority." (Mohammed Bajwa)

GROUP COMPOSITION AND PERSPECTIVES

From the background of every group member's involvement with the building of many types of information systems, it became apparent that this working group had to cover the issues raised by a mix of both manual and IT systems and the disciplines of both planning and implementing as well as managing their use.

BUT, for the working group to offer suggestions, we must as the opening paragraph of this report says, take account of the context within which we all work. This differing Economic-Social-Political context means that we must take account of these factors :

- some countries have developed an extensive IT infrastructure and are managing and improving;
- some countries have implemented elements of IT infrastructure and are completing the job; and
- some countries are just beginning.

PROBLEM DEFINITION

Our initial discussions identified some key problems of concern to all members in all contexts.

Why do systems fail?
What are 'Information Systems'?
How to make them work?
What are 'Information Systems'?
How do we achieve a focus on top management support ?
How do we include operational business systems ?
How do we meet 'User Needs' within organisation ?
What aspects of methods help us address unstructured, 'Soft' business problems ?

Furthermore, how do we plan :
Policy
Information Needs
Implementation
Training ?

The group came up with a checklist of detailed considerations which are to be met.

A. To meet user needs, address the following.
1. Establish business aims and objectives
2. Establish categories of users and categories of needs
3. Set scope of technology requirements and limitations
4. Identify extent and source of funding
5. Get top user management commitment and make them see what IT buys them

B. Consider these environment and infrastructure considerations.
1. Availability of finance
2 Availability of skills
3. Communication facilities
4. Technical equipment availability
5. Standards for methods and implementation will assist the establishment of good practice in documentation and assigning project roles

These considerations raise yet more issues
- Are the above resources available, or is their requirement a constraint or a limitation?
- How can a developing country aquire such resources ?

C. At a more detailed level, a number of priority issues are added to the list of concerns.
1. Changing business needs
2. Changing their roles
3. Identifying user roles
4. Information flexibility
5. Centralised and decentralised approaches.
6. Portability, the planning horizon and replacement strategy
7. System integration/data interchange
8. Operational issues
    - quality of service
    - use of service
    - documentation

D. Lastly, the group grappled with the thorny question of the justification of IT, and listed these issues.
1. Immediate cost
2. Long term cost
3. Cash/people benefits
4. Service (new/improved) benefits

CURRENT SITUATION - STATES OF THE ARTS

The group reviewed current practice, as is customary, and considered the following as inputs :

The Plenary Session Presentations on Merise and SSADM, IDEAS, NIMS, ISP and DAFNE

In addition, Itoko Suzuki submitted a paper on the UN Guidelines, Annex A.

Our third round of inputs was a round-up of National Experience from UK (Messers Hopkins and Firth), France (M Jourdan), Latin America (Messers Evangelista, Oquist and Sulbrandt), Pakistan (Mr Baswa), Denmark (Mr Flindt) and China (Professor Tu)

Finally, many members of the working group felt Mr Hearle's observations in the Plenary session should be kept in mind.

(A paraphrase of Mr. Hearle)
Methods are better at analysing requirements, the current, rather than the creative activity of design, which is oriented to the future. Methods, therefore, must :

- cater for costs of change in plans/tests
- plan for human problems
- principle implementation strategies

They must allow for phased implementation "great gulf tactics" and prototyping, which all need to be deployed at the right time.

Above all methods are no substitute for highly skilled staff with experience of implementation, not just theoretical knowledge. There must also be an appreciation of management roles. The group drew conclusions from this experience. It was agreed that proposed methods must embrace:

Appropriate Conceptual and Life Cycle Models	- user roles
	- organisation plans
	- user/national education/awareness
	- Information integration/Standards
	- Decentralised/Centralised Approach
	- Implementation Strategies

ISSUES

The working group then assessed the UN Guidelines (Annex A) in the light of these opinions and reviews of experience. It was decided to home in on three key issues - Information Needs, Standards and Training.

Issue 1- INFORMATION NEEDS (Mr Hopkins (UK) and Mr Pelella (Italy))

a) An IT planning approach should help identify actual needs. To do this it will need to assist developers plan systems to meet the following criteria. User information needs mean :

- the right information - no redundancy
  - no overlap
  - no conflict
- the right scope - the right organ
- the right people/user/functions
- the right business activities

And what does this word 'Right' mean ? It will be represented by those elements of a system which are :

- critical to sucess
- flexible to future change
- relevant to goals in Business Plan
- have benefit/cost justification
- more effective use resources
- tangible/intangible

b) The Planning approach must take into account the future sneaking up in the guise of organisational and policy change. And change may come in many guises - political, legal and/or economic

c) The Planning approach must provide techniques for information analysis and management

d) Part of the planning activity will be to monitor information held, and to assess its quality in the way it relates to business priorities. This is commonly done by SWOT analysis, in terms of Strengths, Weaknesses, Opportunities and Weaknesses

e) Finally, it must be remembered that structured methods are particularly important in the context of information gathering systems where the requirement can be precisely defined. Decision support information systems are much more user driven, and require flexible facilities to address the presentation and manipulation of information to reflect changing needs. To this end, emphasis should be placed on approaches which address 'Soft' Business problems. The ideas of Checkland and Wilson are relevant here.

Issue 2 - STANDARDS (Mr. Firth, UK)

STANDARDS TO CONSIDER

1. Methodology Standards - important to begin somewhere, so start now, and consider selecting perhaps more than one. Establish standards which control documentation, and enforce them internally/externally.

2. Data Standards are vital to achieve quality of information

3. Security standards will promulgate and educate by providing procedures for all users, as well as establishing good practice on secure access to data. Conference delegates are advised to always consider the legal aspect.

4. As for Technical Standards, it should be remembered their objectives are :
    - portability/connectivity
    - multi-vendor sources of supply
    - international
    - procurement policy

   For a government it is vital to avoid lock-in.

5. Quality Standards - ISO 9000 should be a a benchmark of supplier quality.

Issue 3 - EDUCATION AND TRAINING AS PART OF INFORMATION SYSTEM STRATEGY (Ms Suzuki - UN)

I. Themes:

A strategy for government information systems should include education and training programmes as its integral part. Effective training requires that there be strategic programmes to train all necessary staff involved in systems development and maintenance in accordance with the system's life cycle, and that senior managers participate in formulating realistic training programmes.

II. Categorisation:

a) IS specialists (systems analysts, programmers, data base specialists etc.)
b) Systems support personnel (operators, data entry personnel, data collectors etc.)
c) User (general administrators as end users, senior and middle managers and policy makers)
d) Trainers

III. Strategies

1. Methods and timing of the training of each category should be relevent to the system to be developed and attuned with the system's life cycle.

2. At a government policy level, make plans for all categories above integrating possibly with national educational programmes and/or public service's development programmes.

3. Within an IS project proposal, include a staffing and training plan (analysis of skill requirements).

4. Separate short-term or temporary needs of specific skills from permanent needs of skills.

5. For IS professionals, consider flow between private and public sectors, change in recruitment and wage policy as may be required, (e.g. new post classification for scientific and technical personnel in the Civil Service may become necessary), and their career paths.

6. In strategic national information systems planning, consider including, on a priority basis, IS to be established for personnel management and human resources forecasting in Ministry or Department of Personnel Management. Such prioritized IS may facilitate implementation of the education and training required for the public administration as a whole.

7. Consider training of all above categories as management responsibility to manage both information and human resources in public administration.

8. In user training, give priority to senior managers and policy makers' orientation programmes, content of which may include underlined notion on the role of management in IS projects, legal/procurement/standardization issues, evaluation, training and what IS can do for management. Do not include computer training in such a high-level orientation programme. Such an orientation programme could best be organized in an inter-departmental (or inter-ministerial) colloquium to enhance future co-ordination, standardization, information sharing etc., within the entire public service.

9. For senior computer professionals training, include management training which may facilitate their understanding of how the organization works. Joint training programmes for management and senior computer professionals may be useful for effective IS development.

10. Training of data collectors should be underlined as essential for successful IS implementation, and its implementation should be synchronized with the system's life cycle.

CONCLUSIONS AND RECOMMENDATIONS

1. We urge and encourage conference colleagues to adopt a methodological approach to all system development.

2. Selection of methods needs to take into account the conceptual and life cycle models of candidate methods

   These must be appropriate at one of these levels at least:
   - the IS project
   - the organisation
   - a standard for a national government

3. It is recognized that methods help identify users and elicit user requirements, but the role of the user is an immense topic in its own right.

   We recommend that DFD consider tackling the topic of the role of the user
   - in planning
   - in requirements specification
   - in education, promotion and training
   - in operation and
   - from an organisational, psychological point of view.

4. We urge conference colleagues to take note of the conference message that methodologies are stronger on planning, analysing and specifying systems than providing help with implementation. To complement the adoption of appropriate methods, we urge colleagues to publicly announce their intention to adopt appropriate international standards particularly in the areas of OPEN SYSTEMS, information resource management configuration and quality management.

   Such national statements of intent will be a clear message to suppliers who may be encouraged to better meet governments' clearly expressed needs as major customers.

5. Furthermore, we call on international agencies, including the UN, to consider taking an active role on coordination and promotion of various international standards so that all countries benefit from the greater opportunities for open systems, integrated information resources and operational flexibility.

Annex A - MANAGEMENT OF INFORMATION SYSTEMS : AN APPROACH TO POLICY DEVELOPMENT IN DEVELOPING COUNTRIES

Consult following background paper for contribution by Ms. Itoko Suzuki.

Annex B - NICARAGUAN VIEWS - PAUL OQUIST

Economic information system policies and strategies for public administration must be structured within the parameters of a nation's current and forseeable economic, social, cultural, informational and political contexts. They must also be derived from the objectives of national economic policy.

A policy on strategy which fails to take into account these factors is unlikely to gain approval if approved. It would be difficult to implement, and if implemented, it would have a high risk failure.

Economic information systems in public administration are power elements crucial to the capability to formulate, execute, and evaluate economic policy.

The nature and degree of development of a nation's economic social, and cultural structures from both the resource base and the structural constraints for systems implementation. Quite obviously educational levels are of particular relevance. The more comprehensive and decentralized a national system is, the more it must take into account the correlating educational levels of relevant occupational categories throughout a country.

The structure and level of development of informational processes are an integral part of a nation's global social structure. As such, economic, social, cultural, and political development can be facilitated or hampered by the nature and degree of development of information processes. The attainment of processes organized into systems is a crucial qualitative advance in the development of the basic informational structures of a society.

Bask informational structures and on-going processes of social information formation and distribution are conditioned by: social attitudes towards change; informational traditions among the openness-secretiveness - distributive- hoarding and centralized - decentralized dimensions, among others; the degree of scientific and technological development; the nature, quality, and quantity of the information demanded for diverse purposes at different decision-making and management levels, among numerous other elements.

The complexity of the impact of the global economic, social, cultural, informational, and political structures of public administration information systems is such that there can be no fixed model nor formula for their development internationally nor even for the same country at different stages in its development.

Obviously, however, the foregoing does not exclude the validity of universally applicable scientific principles which must be adapted to national conditions. Among them, one of the most universal principles is the importance of standardization for the capability to collect, classify, process, aggregate, store, retreive, communicate, analyze, and use information of decision- making and management purposes.

Conceptual standardization and the design and implementation of standardized information flows is indeed, the meta-methodology of information system construction.

In the formulation and execution of information system policies and strategies, the two weakest elements tend to be needs assessment and evaluation.

The planning, design, and implementation of information systems requires the combination of theory and practice in order to resolve problemmatic situations and achieve objectives. The determination of their directionality requires the assessment of needs and the identification of interests of different relevant groups at diverse levels. These needs and interests must be identified, articulated, and aggregated by priorities.

This process is most complex and made more so by the fact that needs and interests are dynamic and subject to change across time. Within this complexity, decisions must be made to formulate objectives which define the scope and directionality of a given information system program or project.

Evaluation should be based upon the degree of objective achievement and the degree of satisfaction of the interests and needs that led to the formulation of a given set of objectives.

In summary, policy and strategy decisions should be based upon a structural analysis of the relevant context and they should emphasize need assessment and evaluation. All of these elements constitute more complicated and difficult tasks than the treatments of technical problems and options. Most information technology practitioners are also better prepared and more favorably predisposed to emphasize technical rather than other considerations. If these tendencies are not balanced with contextual, directive and evaluative elements in policies and strategies, they may lead to negative results. This is particularly the case in underdeveloped countries where the risk of adopting technologies without adapting them to the national context is the greatest.

Annex C - PAKISTAN VIEWS, MR. MOHAMMED BASWA

Methodologies for Planning, Design and Implementation of Information Systems - A broad framework

1. Information is a resource and a very powerful rsource. Its widespread diffusion within an organisation or a society carries a great many benefical effects. In developing countries concentration of information in bureaucratic hands has led to monopolistic control and computerisation, with deeply beneficial effects in the society. For better service of societal interests, it is essential that the governments should take a leading role in the diffusion of information and the related technologies, using its own agencies and should adopt realistic attitude to overcome constraints arising from cultural, historical, economic and political issues. However information systems developed with the application of modern computer systems also lead to concentration of information in state data bases and if kept out of public scrutiny, may reinforce the bureaucratic and technocratic power of the administration. The right of access to information with some safeguards, thus, assumes a priority.

2. Sometimes the decision support systems and economic information systems are talked about as separate entities. In reality, there is neither any difference nor dichotomy between the two. Implementation of any decisions, in the ultimate analysis, boils down to and carries financial and economic implications. So in reality all information systems are economic information systems.

3. Information is vital for improvement in management of public affairs through better management techniques, policy analysis and administrative reforms without adequate, recent, valid and correct information, decisions made by bureaucrats or public leaders in lunches, may lead to disastrous results and the damage so done may remain irreparable.

4. Computer technology or information technology (IT) as it is now called has opened up immense possibilities for better administration /management with the help of data and hard facts. Proper development of the information systems within any organization or society (country) is therefore of essence of the matter.

However, information systems are not to be developed for the sake of developing. They should be need specific. These are very costly systems and require a lot of capital outlay. We cannot afford to be profligate with them. Resources, after all, are not unlimited in any society may be developed or underdeveloped. It is therefore, essential to set up an overall information policy for any organisation or country. Then an information needs assessment should follow. The assessment should include staffing and skills assessment, long-term strategy for staff recruitment, training and career development and user management training, particularly at senior levels. This is especially important for developing countries, where the managers lack technological orientation. For playing a leading and promotional role, an execution of national policy, the government should set up a central agency like a national computer board or central information bureau charged with the responsibility of establishing and promoting information systems and improving cooperation with the private sector. Priority should be given to improving operational efficiency eg. quality of service at equal or lower cost and better decision-making. Such a board should function under the chief executive to carry necessary prestige and it should be adeqately staffed with managerial and technical experts. It should concentrate on establishing long-term strategy in consultation with all the Ministries and private bodies and leading business houses like Chambers of Commerce and

Industry within each Ministry or Body, information cells should be created for implementation, coordination and pursuing of national and organizational goals in setting up information systems for improving national productivity.

4. The National Board or Information cells at lower level should undertake information technology projects in the principles of project management, fixing priorities and responsibilities in the line management breaking the project in the stages and evaluating the achievement of the end of each stage in terms of physical achievement, cost difficulties encountered and lessons learnt for future. Both the National Board and the Information cells should conduct periodic surveys in the current status of systems development and identify problem area requiring their attention.

5. The present and future belongs in the information systems and technology. The gap between developed and developing nations would further widen if the latter don't catch up or lag behind introducing information systems. Data base is very weak and even non-existent in developing countries. Information is kept secret either for personal ends or for narrow irrational reasons. It is not necessary that computer technology should be intoduced in all information systems. The introduction of the computer is to depend on cost-benefit analysis and on local/situational factors. What is essential is that information as a resource should be available to all those who need for better ends of the society, no matter whether it is manually kept or computer manipulated unless state or trade secrets are likely to be jeopardized with outside flow of information.

MANAGEMENT OF INFORMATION SYSTEMS : AN APPROACH TO POLICY DEVELOPMENT IN DEVELOPING COUNTRIES

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INTRODUCTION : INFORMATION SYSTEMS AND PUBLIC ADMINISTRATION

Given the current prevailing role of public administration in national governance and development, particularly in developing countries, the search for improvement in management of public affairs through better management techniques, policy analysis and administrative reforms has become a major concern of policy-makers and leaders of public administration. In this framework, the information system has provided a powerful tool for improving management techniques and policy analysis, and has given an important agendum in administrative reforms. Public administration of several countries now has to compete with the private sector management. Therefore, the information systems have to be more vigorously utilized to improve their performance.

At the same time, the use of information systems needs presently, more than ever, the close attention and strong support of the leaders of public administration to manage them properly. Current use of information systems in public administration is generally far from satisfactory in many countries, and poses a number of issues. Particularly, misuse or over-informatisation; inadequancy of security or safeguards; absence of appropriate regulatory mechanisms; lack of trained staff; slow process of implementation due to lack of interest of managers; over-centralization; etc., all call for appropriate **management** of information systems.

In several economies, moreover, a collective set of information systems has provided an emerging social infrastructure, comparable to other infrastructures such as roads, railways, etc. Policy development in this regard has become a rigorous concern for national leaders and policy makers.

For these reasons, management of information systems has become a major responsibility of strategic importance in public administration. Guiding policy and strategies for the management of information systems have been pursued.

In developing countries, in particular, public administration can set the tone as a major use of information technologies in their countries, promoting information industries and systems, and developing requisite human resources. Within public administration, in many cases, central guidance institutions can play a leadership or facilitator's role together with technical leaders in this respect. They can develop policy options on the management of information resources within the public sector and the society as a whole. Their functions of policy analysis and guidance, and their network with political institutions, collegiate public sector agencies, as well as economic and social leaders, have to be supported by additional knowledge on this emerging responsibility.

In this context, the United Nations Department of Technical Co-operation for Development (DTCD) recently published a monograph on strategies and policies for management of government information systems,(*) as a reference document for national leaders and policy-makers in the central guidance institutions in public administration, and concerned professionals.

This short paper explains DTCD experience and its approach to policy development in developing countries adopted during the last five years, and discusses some of the prevailing perceptions and methodologies in public administration in devising guidelines for the productive use of information systems in public administration. The currently attached guidelines are derived from the deliberations of the United Nations Expert Working Group on Management of Government Information Systems organized in December 1987 in New York.(**)

TOWARDS POLICY AND MANAGEMENT DEVELOPMENT FOR GOVERNMENT INFORMATION SYSTEMS

Two interrelated perceptions were predominating in our activities during the period. One was the necessity of the intervention or involvement of senior management in the use of emerging, powerful technologies. The other was how to encourage and secure such necessary involvement.

During 1982-83, DTCD identified and researched several major issues pertinent to development of information systems in public administration in developing countries. At that time, various issues were studied from policy making and organizational management perspectives. The guiding principle was that the performance of the technology is dependent on the organizational policy and management which govern its use.

The research led to the following recommendations (***) addressed to policy makers and senior managers in public administration. These were formulated generally in order of preference to be adopted :

1. Initiate development and implementation of national policy on information systems
2. Establish institutional arrangements for information systems policy, management and technical support;
3. Require information systems planning at both national and agency levels ;
4. Support and encourage education and training in information systems at all levels: users, systems professionals, high-level public servants and the general public;
5. Provide incentives to motivate and retain skilled information systems personnel;
6. Promote sharing of facilities and information among government agencies;
7. Require that government agencies promote the use of a formal methodology for the development of information systems.

(*)Forthcoming United Nations publication ST/TCD/SER.E/10

(**)The United Nations Expert Working Group on Management of Government Information Systems was organized to review and analyze major issues in developing long-term policies and strategies for government information systems and to formulate guidelines on the management of information systems in development.

(***)See UN/DTCT document "Modern Management and Information systems for Public Administration in Developing Countries" ST/ESA/SER.E/36, pp. 51-53.

In essence, the above study emphasized the crucial importance of management involvement in the promotional or effective use of information systems at a system's or organizational level. In public administration as a whole, administrative management as a function of the central guidance and management institution in the government has to involve and arrange the organizational mechanism for the requisite policy and management development.

During 1984-85, among the above recommendations, DTCD singled out the concept of requisite involvement of senior management, in systems development, and initiated a user-manager training progrmme. DTCD organized a pilot sensitization programme for senior government officials on the use of information technologies in public administration in 1985 in Sweden. Based on this training experience, we prepared a training package as a reference document for public sector organizations of developing countries to organize similar senior managers training as users of information systems (*)

The content of the requisite knowledge and skills perceived to be needed and/or useful for senior government officials in the training package includes:

1. Basic computer and communication technology literacy;

2. Priority setting in the applications of information technologies in public administration and methods for information systems planning;

3. Parameters and issues in management control of information systems;

4. Laws and regulations;

5. Procurement and contracting policies and practices.

A self-evaluation of the training package led us to explore more concrete methodologies and skills in a simple form of do's and don't's on the above themes, included in the training package. Search for such concrete recipes for senior government officials was also prompted by the revitalized emphasis placed on the issues of management of government information systems by the United Nations Eighth Meeting of Experts on the United Nations Programme in Public Administration and Finance held in New York in April 1987.

This meeting, which reviewed the overall issues, priorities and measures in public administration and finance in developing countries, among others, identified major policy objectives for the management of information systems in public administration. Firstly, the need to develop strategies and policies in national public administration was underlined. Secondly, standardization and procurement were set as crucial steps to increase efficiency and productivity in implementation strategies. Thirdly, the need for methods in planning, assessment, design implementation and maintenance of information systems as well as legal aspects were emphasized. Lastly, management training, particularly user-managers training, was re-emphasized as an effective strategical element for policy development.

PARADIGMS OF INFORMATION SYSTEMS DEVELOPMENT AS A STARTING POINT

In pursuing policy development guidelines, the afore-mentioned United Nations Expert Working Group on Management of Government Information Systems recognized and categorized the different patterns of development of government information systems based on their observations of the worldwide situation. It was considered to be important for policy makers to know where they stand in order to proceed in their own policy development.

(*)Training package prepared by DTCD entitled "Use of Information Technologies in Public Administration", TCD/SEM.86/5

The Working Group arrived at the following four types of development:

1. Large, stand-alone systems without effective linkage of information

2. Small, scattered systems.

3. Combinations of large, stand-alone and small, scattered systems.

4. Work station-oriented systems with information-sharing and technology-sharing characteristics.

The last type is the ideal one, as it allows for sharing of information and provides the most productive outcome, especially at a time of resource shortage. Very few developing countries have entered this type of proliferation, but it is to this type of situation that all are pointing. DTCD's technical co-operation activities serve all types. A national strategy has to be based on the current situation and a vision for the trend, as well as the administrative systems and economic situation.

GUIDING PRINCIPLES AND METHODS OF DEVISING STRATEGIC GUIDELINES

The working group was attended by public administration specialists, lawyers, scholars, information systems personnel, training specialists, management development professionals and senior administrators. The mix of above expertise was fortunate, for guideline building requires various kinds of expertise, just as a central guidance network in public administration always does. Also fortunate was the fact that all participants have at senior level in government, extensive experience in information systems development, management and/or control. They were either administrative or advisory capacity in formulating government policies and strategies in information systems development.

In devising strategic guidelines, along with technical and legal knowledge, some organizing principles familiar in the public administration community, and management skills were extensively applied by the working group.

For instance, policy analysis techniques are used in formulating major government objectives and prioritizing activities. In developing strategies and policies on the management of information systems, the same techniques can apply.

Likewise, techniques of administrative management could guide the establishment of a focal point in co-ordinating and sharing information and information systems in public administration. What role the focal point purports, whether its capacity will be advisory, authoritative or supportive, depends on the paradigm of administrative systems as well as information systems development as described above.

Various methodologies of information systems planning and design, also involve several management techniques and common sense in organization. For instance, participatory management notion is reflected in the underlined steps of involvement of management and all others concerned in systems planning. Consensus building, consultative committee formation, task force or matrix management, are commonly used organizing skills in management and are infused in the systemic steps adopted by various prototype methodologies in information systems planning, design and implementation.

Below is an outline of the guidelines developed by the working group on policy and co-ordination, needs assessment, procurement, training, standardisation and legal and regulatory issues.

ORGANISATION AND MANAGEMENT ISSUES

These guidelines are in no way considered to be comprehensive or applicable to all public administration systems. The coverage is only demonstrative. Decision-makers will find the first section addressing basic strategic issues.

Once an overall information policy is set, each organization can go through information needs assessment. It is the job of the manager, in co-operation with the information systems professionals. Needs assessment methods may use various approaches. The working group proposed the use of one standard methodology in a given organization for the sake of efficiency and promotion of management process, including monitoring and evalaution.

Procurement of information systems, particularly computer software and hardware and services, needs the serious attention of management due to the relatively large cost involved and the impact of the systems developed, procurement must go through certain standard procedures to avoid waste, inefficiency or corruption.

Needs assessments should include staffing and skills assessments. Long-term strategy for staff recruitment, training and career development to provide the needed skills in a given organization and public sector as a whole must be formulated. Human resources assessment is still lacking in many information systems projects. In addition to professional development, user-management training is still neglected. User-training is also recommended to include senior management training, as an essential input to information resources management.

LEGAL AND REGULATORY ISSUES

Several developing countries have not come to a stage of establishing standards, i.e. information systems planning standards, procurement standards, data standards or technical standards, apart from hardware standards which public administration cannot alone establish. It is common knowledge that standards help to promote cost-effective information systems development and maintenance. As to where to put standards, it takes a long time to reaching consensus, and no country has been totally successful yet. Choosing a unique and consistent set of methodologies covering information systems design and implementation certainly assures the effective and efficient use of information technologies, and thus favors the managers of public administration.

In the broad environment of information systems development, legal framework of government information systems is gaining increasing importance at the moment, particularly in developed countries and this trend is generally being followed in many developing countries. Issues that are of pressing importance include privacy, computer fraud and security, access to government information by citizens and the private sector, and transborder data flow. There is no formula for any of these, as it pertains to the legal system of a given country as well as other conditions.

CONCLUDING REMARKS

These guidelines are limited as they are mainly addressed to the public administration community involved in overall policy on administrative development, co-ordination of information systems in government, and human resource management development in the public sector. Acknowledging these limitations is important, as significant developments in policy on computerization can occur in different sectors.

However, since public administration is embroiled in larger forces in the entire society, its effectiveness and efficiency is vital to the entire society. Its role in the national policy and strategy building for the use of information systems is crucial for the improvement of management of public affairs.

This emerging responsibility has been placing strains on available but scarce resources, decision-making processes and visions of policy-makers. Through the examination of the state of the art in each government, through knowledge diffusion from other nations based on their experience and through international technical co-operation, these strains may hopefully be alleviated and opportunities for the right course may be enlarged. In this context, continued effort of national governments and the international community would be essential to refine their policies on this strategic subject.

WORKING GROUP B

PRACTICAL WAYS AND MEANS TO TAKE INTO ACCOUNT PLANNERS AND DECISION MAKERS NEEDS IN THE DATA COLLECTION PROCESS AND IN THE PLANNING AND DESIGN OF INFORMATION SYSTEMS FOR ADMINISTRATIVE OPERATIONS

Chaired by:
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THREE PROPOSITIONS

After a spirited initial discussion, three propositions were accepted as the basic building blocks on which the work of the group should focus:

1. All planning and design of systems must be user driven, because systems must be built from real rather than perceived needs to be useful and sucessful.
2. Determining real rather than perceived user needs is best done by studying the environment in which functions are being performed.
3. Although the information needs of planners and decision-makers are not always or necessarily the same, for the purposes of the group's work, they would be treated as similar.

THE KEY ISSUE

The key question of the working group focussed on a very specific issue:

What, if any, were the differences in the environment and functions performed in developing nations viz-a-viz the role of public administration when compared with developed nations?

The intent of focusing on this issue was to try to identify whatever differences seemed to exist in order to see if there were constructive roles for developed nations to play.

A general concensus emerged early in the discussion that there were, in fact, a number of problems in developing nations that were different than those in developed nations particularly as they involved resources.

It was also agreed that the resource discrepancies between developed and developing nations for planning and designing information systems varied dramatically in four areas:

- professional people
- equipment
- software development and availability
- appropriate institutional organization

A further concensus emerged relating to the relative importance of these problems. Specifically, it was agreed that, both for the short and long-term planning horizon, the lack of appropriate institutional organization was the most serious limitation for meeting the needs in the data collection process and in the planning and designing of information systems for administrative operations.

The group did not minimize the formidable obstacles presented by the other problems, but they were deemed manageable. Briefly, the line of argument which was put forward to support this contention went as follows:

Professional People

Lack of professional people could be resolved or at least minimized by proper training. In China, as in other developing nations, a pool of potentially capable people was available. Moreover, many training program models are available throughout the world and cooperative or joint ventures with other nations both developing and developed are possible. At worst, then, the problem was short-term.

Equipment

Equipment problems were generally of two orders: insufficient or inadequate range of machines; poor or lack of proper application. In the case of insufficient or an inadequate range of machines, it could be solved by more money. Lack of proper application on the other hand related to needs identification and generally resulted from organizational limitations.

Software

Software, like equipment, was not a problem when standard systems were involved because such software could be purchased off the shelf. When special applications had to be met, though, two factors were inhibiting: the pool of professional talent available for the project, and the organisational constraints in which systems were to be designed and implemented. Once again, it was felt the problems emerging from any temporary shortage of talent could be solved reasonably simply, and in a variety of ways, but the same could not be said where organisational constraints were involved.

APPROPRIATE INSTITUTIONAL ORGANISATION

The problem of inappropriate or poor institutional organisation, although common to both developed and developing nations, was believed to be far more serious in developing nations by participants in the workshop. This was considered the most damaging drawback to systems building and implementation, and because of the above it was difficult to put in place good **information management** procedures.

The reasons cited by participants from their experiences centered on four types of systemic breakdowns:

- problems of communication (e.g. insufficient knowledge about internal goals; projects in other ministries and departments; work in other parts of the national and international communities);

- problems of coordination and duplication (e.g. in data collection; equipment purchases; staff utilisation; departmental evaluation, renewal and creation);

- problems with procedures (e.g. who is to collect official data? how is data to be shared? who is to determine when and how to merge manual systems into evolving machine systems?)

- user problems (e.g. lack of emphasis on ensuring systems developments are user driver because of insufficient consultation with systems designers and markets to be served).

The need to find solutions to these types of organisational problems was believed to be of the highest priority on the basis of five lines of argument:

1. Information management underpins all effective systems design and can not be done well unless understood by those involved in the planning and implementation of systems and unless coordinated properly within the environment in which the functions must be performed;

2. Appropriate data collection is central to the design and planning process. To gain the right data one must be able to describe with precision who is to be served, why, and in which environment;

3. Functions must evolve continuously to remain effective, but it is essential they evolve within a stable organisational environment or that they are reviewed or altered through clearly understood procedures;

4. Optimum staff utilisation and training, together with sound equipment choices for system development, are far more difficult to achieve in an inappropriate organisational environment.

5. The potential of "networkings", the single most important by-product of the communication revolution can not be put in place usefully without clear organisational connections.

SOME SUGGESTED SOLUTIONS

Given the foregoing arguments, the discussion concentrated on the issues that evolved from them in order to discuss practical suggestions which might help to improve organisational drawbacks. Among those worth mentioning are:

1. The need for a coordinating agency with sufficient authority to help improve communications within and without government, and to help develop policies, establish goals, set priorities, and ensure the integration of administrative systems, including :

- choice of equipment
- types of data collection
- methods of sharing data
- distribution of data
- standardisation of data
- standards of protocol

2. The need to recognise that organisational mechanisms must be flexible in that there must be both adequate central control of system design, implementation and operation, while still permitting a fair degree of decentralisation in local operations. Put another way: there should not be a single, unitary information system. Information management should be built on individual modules which can be integrated into the system blocks when necessary, or used by other units when needed. Given the context of needs, identified within our discussion group, it was felt that this approach implied there was:

- a need for long-term financial planning (3-5 years) to ensure planned, orderly growth among departments and in order to gain maximum bargaining power in equipment purchases by governments;

- a requirement for understanding the relationship between manual and emerging electronic systems, including the need for a process to determine how and when such systems might best be merged;

- an understanding that good internal communication among planners, decision-makers and staff was essential to good systems design and development, with newsletters, seminars, special meetings, and group discussions as important ways to help improve and maintain communications channels.

3. The need to understand that organisational reform and adjustment was always a difficult and lengthy process, so that ways had to be found to work within the political process, without jeopardising the system planning and design necessary for effective governance. One of the more obvious approaches for minimising disruptions is to use technology as a method for bridging gaps as changes occur.

4. On the basis of the foregoing suggestion, it would be useful to consider a conference or seminars with the purpose of dealing with "networkings" within new and evolving systems. The particular emphasis should be to help developing nations to understand how to plan and design systems which can be linked at a later date, despite the inevitable changes within government departments which will result from reforms which are instituted to improve their responsiveness to exogenous forces.

WORKING GROUP B - BACKGROUND PAPER

STRATEGIC PLANNING AND IMPLEMENTATION OF INFORMATION SYSTEMS IN GOVERNMENT - ECONOMIC CONSIDERATIONS

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INTRODUCTION

The introduction of Information Technology (IT) - or as it was called twenty-five years ago ADP - Automatic Data Processing - was, as in many other countries, not planned or based on a master plan.

Only a few years later, did the Ministry of Finance establish a central department to coordinate ADP use in Government Administration. The Veto power of this department was used in two ways:

1. By approving or disapproving budgets for the ministries or agencies;

2. Even if the budget was approved by the annual Budgetary Law, the Special Committee for Procurement, controlled by the Ministry of Finance, could and did make decisions on the purchase of ADP equipment almost at will - via its negative Veto Power.

A Council on ADP composed of representatives of various ADP managers from different ministries was trying in the 1970's to coordinate and give guidelines to the ADP department in the Ministry of Finance. The Council was not always very successful, as it had no legal power to impose its decisions on the ADP Department in the Ministry of Finance.

This policy of tight control was characterized by constant power struggles between the ADP department in the Ministry of Finance and the various computer centre managers in the ministries and other agencies. In this period decisions were, usually, based on the power position of the particular ministry and not on technological requirements.

There was no central planning as such and no one really knew how efficient the systems designed were.

For many reasons, the ADP department in the Ministry of Finance was disolved in 1980. For about three years only very loose control - via the budgetary law - over ADP activities was, in fact, in existence.

In 1983, two major steps were taken by the Government which led eventually to the 1987-1992 Master Plan:

1. The Minister of Science and Development and the Minister of Communication in Israel appointed a Committee on Telematics. The task of this committee was to present recommendations for an information technology policy for the State of Israel.

2. The Accountant General's Office and Bureau of the Budget in the Ministry of Finance have created two functions for policy coordination of Information Technology and the control of IT projects in the government.

In the Bureau of the Budget the position of Director of Information Technology was created and the Deputy Accountant General and his staff were assigned the power to deal with IT matters.

The purpose of this paper is to present in short, how the Master Plan for a national policy on IT for the years 1987-1992 is and will be implemented. This policy which is being implemented within the guiding organisational principles of decentralisation, on the one hand, and principle of control and audit, on the other hand.

Furthermore, with tight economic resources available, economic considerations influence the implementation.

Israel Steering Committee on Telematics in Government - (ISCT)

In 1983, the Minister of Science and Development and the Minister of Communication in Israel appointed a Committee on Telematics.

The Committee's task was to present policy recommendations for the development and adaptation of computerisation and communication in Israel. This committee included top representatives of industry, labor, academics, as well as public officials and ADP professionals.

The Committee divided its tasks among various, mainly sectorial, sub-committees. All sub-committees have submitted their final reports during the latter part of 1984 and the beginning of 1985.

The contents of these reports included recommendations for future policies. The reports were adopted by the planery of the Steering Committee and were in principle approved by the Israel government.

These reports serve as guiding rules for present and future policy and will be implemented as funds become available.

The ISCT's recommendations on education, training and retraining are already being implemented in order to help in solving immediate employment problems and prepare future personnel for high technology industries.

The recommendations of the Sub-Committee on Telematics in Government Administration saw as its major objective to suggest policy measures to improve government administration and make it more efficient through computerisation and office automation.

The major recommendations of the Committee - their order not necessarily being according to their importance - are the following:

a. Encourage the awareness, understanding, and usage of information systems among top government officials.

b. Create a consistent policy towards maintaining future developing of proper ADP standards in government.

c. Establish three central data bases: population; land registry; and make them available for use to all government agencies accordingly - though restricted to their specific needs.

d. Establishing an intra-government data communication network.

e. Reenforcing the personnel in government ADP departments, especially those found to be comparatively weak in experience proficient personnel.

f. Establishing a central computerised data base which will include information on software packages and master files in use by the various government departments.

g. Encourage the purchase of office automation equipment and software.

h. Building an online public information system with terminals available for use by the population in public locations.

i. Coordinating between Government ADP centers and/or reorganizing them in such a way that will create an environment suitable for the establishment of a central Government policy on Telematics.

j. Despite economic conditions, setting a time and budget schedule, that will enable to begin implementing some of the recommendations of the Telematic Committee.

k. That one Ministry will be responsible for the coordination and control of the implementation of the Telematics Committee recommendations.

It is felt that due to the fact that all public and private sectors of Israel (economic and political) were involved in the deliberations and the writing of these reports, there is a very good chance that most of the recommendations will be implemented in the long run.

IT AUTHORITY AT THE NATIONAL LEVEL

In order to understand how the IT policy in Israel is operating, it is advisable to look at the organisational framework of the Government of Israel and its Information Technology Planning and implementation set up. (See Appendix 1, 2, 3).

The following are the present guiding principles for national IT policy in Israel:

1. An IT strategic planning five year Master Plan 1987-1992.
2. Constant updating of the Master Plan due to technological development and the fact that we, in Israel, are "believers in improvisation" and that "any plan is a basis for change".
3. Planning an annual work implementation schedule based on the Master Plan, including guidelines and procedures.
4. Initiating infrastructure projects: national communication network via coordination with the PTT and i.e. other ministries.
5. Approving IT budget allocations for ministries and agencies.
6. Setting and operating the Central Procurement Committee for IT large bids for hardware - including assistance in choosing between various alternatives.
7. Initiating annual centralized proposal bids for micros, terminals, printers, etc.
8. Preparing a general standard procurement contract with hardware, software and communication companies for the whole government IT establishment.
9. Controlling and auditing of Master Plan implementation
10. Assisting government computer center managers in solving their problems with hardware manufacturers and software houses, where the centers cannot solve them on their own.
11. Steering and coordinating interministerial IT planning in government.

12. Initiating new IT projects within ministries, which are needed for the benefit of the public, but are not scheduled by the ministries because of lack of knowhow, knowledge, fear of change and/or plan conservatism.

IT Authority at The Ministerial Level

The following are the guiding principles and the authority vested in the computer center of a ministry, agency or any other independent division:

1. Developing of a ministry IT master plan and its up-dating.

2. Planning annual IT working schedules for the ministry of agency, including the budget.

3. Integrating ministerial needs within national framework of the IT master plan.

4. Responsibility for choosing hardware and software for ministry.

5. Responsibility for IT project development within the ministry.

6. IT coordination and cooperation within ministry in the field of informatics.

7. Coordination with IT functinaries in the Ministry of Finance.

8. Coordination with other ministries and agencies.

9. Production implementation and control of IT within ministry including guidelines and procedures for implementation.

10. Developing of procedures and guidelines for control of information flow within ministry.

11. Issuing working procedures and guidelines for security measures needed as a result of a new privacy law in Israel.

12. Coordination and exchange of information via the Forum of Computer Center Managers.

POLICY IMPLEMENTATION

Objectives

The national IT plan has 5 general main objectives:

a. To elevate the productivity and efficiency of government administration

b. To introduce better services to the public via on-line terminals situated in various public places for the benefit of the people.

c. To take advantage of competition between vendors and the encouragement of this competition by not granting monopolies to any vendor catering to the government public sector, thus receiving better services.

d. Establishing of national data bases in the field of land registry, population registry and data base on industrial and services oriented companies.

e. To benefit the individual citizen by creating better public services.

Principles and guidelines

1. As stated above the principles of decentralisation and control on the national level and in interministerial activities are implemented under the supervision of the Ministry of Finance in cooperation with all concerned. The following are some examples of such cooperation:

a. The etablishment of a national governmental communications network infra-structure.

b. The establishment of G.I.S. - Geographical Information System for land records.

c. The feasibility study for the establishment of governmental electronic mail system, which is now being conducted.

All these projects are being already implemented will bring a saving of millions of dollars by avoiding duplication, waste and redundancy.

2. The Ministry of Finance, with the help of IT experts hired ad-hoc for a specific purpose, in coordination and assistance of IT managers of different government ministries, decide on the priorities in the implementation of IT projects based on the general IT national policy.

3. The Master Plan itself is based on the Telematic Committee's recommendations. These recommendations are guidelines for the government annual, bi-and/or tri-annual plans of actions in IT field.

4. Each ministry has its own IT budget and, based on its own priorities it will implement a ministerial IT programme - i.e. Ministry of Agriculture.

5. As stated before the general Master Plan is based on the 1983-85. Telematics Committee's report, which are both general national recommendations for action as well as specific plans for certain branches of the conomy, health, agriculture, high technology industry, etc. The National Master Plan will be implemented according to government priorities. This is usually in the field of inter and intra ministerial projects. The establishment of a (G.I.S.) Geographical Information Systems data base is a good example of how a decentralised inter-ministerial project is beginning to work. The following are just part of the list of government and public bodies that have interest in G.I.S.: Land Registry Office, Public Utility companies, Ministry of Agriculture, Local councils.

SOME FURTHER SUBJECTS IN THE IT POLICY - ECONOMIC BENEFITS

The following are some further subjects which will also bring reductions in Government Expenditure:

1. Budgeting IT development projects by length of project rather than by annual budget year, allowing transfer of funds from one year to another. It is expected to bring about better allocation of funds.

2. Subject to the existence of an approved IT Master Plan in a particular ministry, looking at the possibility of budgeting hardware procurement for each governmental computer center in accordance with ADP application development plans and not on an annual basis where money was spent because it existed while hardware was not yet needed.

An example of such an approved plan is the IT Master Plan for the Ministry of Education and Culture, i.e. computerisation of the school system in Israel.

3. Standard contract agreements with hardware manufacturers on a cross governmental level. An agreement has already been signed with Digital Corporation, even with IBM certain paragraphs in their standard contracts have been changed.

All other equipment companies have a limited amount of equipment in the government to want such an agreement.

4. In the field of personal computers and auxiliary equipment the Ministry of Finance signs an annual procurement agreement with equipment companies or their agents in Israel, where the government will send a letter of intent to purchase a certain large amount of computers within a certain budget year, at a maximum price agreed upon.

Each ministry or agency decides from whom to purchase, within the budget year. At the end of the year, the hardware companies will take stock and decide whether to renew the agreement. Usually, the numbers purchased exceed the agreement number. This centralized plan has saved and reduced costs by about 40% in the purchase of micros, terminals, printers and other auxiliary equipment.

5. Word processors and other world known application generators, or specific software are and will be purchased for all government offices at discount prices, every time needed.

6. Another principle adopted by the Ministry of Finance is that if a ministry is not "pushing" a certain IT project, which seems to be needed for elevating the level of public services, the Ministry of Finance will undertake to initiate such a project. One example to be started is the computerisation of the administration of the courts.

NATIONAL POLICY FOR INFORMATION SYSTEMS - 1987-1992

The principles shown above for the period up to and including 1987 will continue to form the basis for the Israel government IT policy for the years to come. With some necessary adjustment needed due to technological changes, we will continue to develop those information systems which are being used and are beneficial to the Israel economy and give better services to the public.

The IT projects to be developed can be divided into three levels:

a. overall national projects

b. individual office projects - ministry, agency or division

c. inter-ministry or agency projects.

A. Overall national government projects

In the next 5 years we will continue the implementation of the Master Plan in the following areas :

1. Finishing the construction of the government communication network infrastructure.

2. Establishing office information systems in the government including electronic mail, electronic archives and the connection between office applications and ADP application in each ministry. An inter-ministerial committee of compuer experts and managers has been set up to study and recommend what standards are to be adopted for electronic mail and eventually for Office Information Systems in Government. This committee's recommendations will be the guiding principles for office automation in the Israel Government.

Office systems standards for word processing and electronic mail etc. will be prepared in order to enable the connection between office systems using different computer architectures, both in government and in the private sector.

3. A governmental computer software and ADP application equipment inventory data base, also enables the central authority to assist in the exchange of hardware between different government offices and in transferring suitable application software from one office to another.

4. The establishment of a centralized governmental financial system by connecting the budget and accounting system of each ministry with the central computer at the Accountant General's Office was initiated. The system is decentralised: each ministry will have its own computer and applications, but certain summaries and other relevant data and information will be sent to the central computer.

Thus, enabling control and supervision of actual expenses of each minstry. It is a four year project. It will save about 10% of annual costs in the first 5 years.

5. Planning and implementation of a human resource system at the ministerial level and at the national Civil Service Commission. This system will connect the individual personnel department in each ministry with the national Civil Service Commission Office. The system will begin with the acceptance of an employee of an office, it will cover his career development plan from the beginning of his work to his pension, including all the training needed, etc.

The system will eable the individual ministry to key in information and the system will process automatically certain changes in the individual employee status, while enabling the Civil Service Commission, control and audit, whether all changes were according to governmental regulations.

6. Government IT procurement policy:

Here the government will continue the policy which has been implemented in the first years of the Master Plan.

a) general standard procurement contracts

b) annual centralized proposal bids for micros, terminals, printers etc.

c) central procurement committee of IT large bids for hardware.

This procedure has shown great economic benefits.

7. The establishment of a G.I.S. system as already stated. This system will be built and run on a commercial basis and will service, as stated, government offices, public utilities, the PTT, local councils, and the individual citizen, etc. This G.I.S. system is planned in such a way that it will service all these bodies, while maintaining their independence and their rights by law. Eventually it will cover its own costs of operation.

8. The establishment of a new Foreign Trade Information System, which will serve as a national information system for all economic organisations involved: Customs, Bank of Israel, Bureau of Statistics, Customs clearing agents, Ministry of Trade, etc. It will help improve import and export procedures and will save the Israel economy certain expenses. It already enables customs clearing agents to enter the system from their own offices (see appendix 4, 5).

B. An individual office project - ministry, agency or division

1. To continue implementation of master plans and annual working schedules for those ministries that have proven in the past, to be operating well. As these plans are a crucial factor in influencing development of computerisation in Government offices.

2. To prepare such master plans for those ministries or agencies which do not have such plans. These ministerial master plans will enable the ministry to define :

a) requirements;

b) alternative IT solutions to the office needs;

c) decide application priorities at the office level.

The plans will enable each ministry to decide on its own priorities, and at the same time, it will also help in deciding - on an interministerial level - IT application priorities. Thus, defining relations and ways of co-operation between information systems in different ministries.

The plans will be based on a set of accepted and/or suggested governmental solutions that were shaped in the past or will be shaped and developed in the field.

C. Inter-ministry or agency projects

These projects will be initiated and implemented, as stated above, by common coordination between all bodies involved. The Ministry of Finance will assist, wherever needed.

ADDED VALUE IT PROJECTS - EXAMPLES

The following are some unique projects, implemented in our country, projects that inherently have some value added.

We would like to explain the problematic nature in implementation of such projects and the significant benefit that the public sector will gain.

In this chapter we will present three such cases:

1. G.I.S.

The first project is the national Geographical Information System (G.I.S.) project, we intend to establish a national database in the following subjects:

1. Land registry
2. Public utility and infra-structure data
3. Planning authorities data
4. Local Councils planning.

In order to set up such data bases, we need the following kind of data:

1. Cadastrial mapping
2. Topographic mapping
3. Infra-structure mapping.

More than fifty different organisations will use this Data Base System. The project includes a great deal of work in standardization and coordination between different organisations, who work in different ways. It will also require planning of a computer center that will enable mass transactions of graphic and logic information between various kinds of computer architectures.

Here in Israel, because of the complexity of the system and the fact that mapping of the country and authority over land is the responsibility of many governmental agencies, it was decided that the Ministry of Finance will have an overall responsibility to coordinate between the various agencies and smooth out obstacles, which are sometimes the result of conflicts over jurisdiction in the field.

The various offices such as the land registry office or the local council authority will remain responsible for designing the system and its implementation. The execution of plans will be based on availability of funds from its own sources.

The control and audit will be done by the Bureau of the Budget and the representative of the Accountant General's Office in each ministry or agency.

The IT manager in the Land Registry Office is responsible for coordination both internally and externally with other interested organisations. He is responsible for establishing guidelines and procedures which will provide the rules for working processes of G.I.S. within the different bodies.

Naturally, these rules have to coincide and be based with the general procedures written by the Accountant General's Office and in coordination with the other authorities sharing the G.I.S. data base.

The fact that all government bodies concerned will be able to access each other's Data Base and receive needed information, will reduce transfer of paper to a minimum. Each input entry which until now has to be entered 5 times at different lcoations will be entered once and all relevant data sent through the GIS network to the right file.

It will bring considerable reduction in costs as well as better service to the public and to the central and local authorities.

2. Public Tax Information Service (P.T.I.S.) for Tax Consultants and C.P.A.'s

Now, we would like to concentrate on the P.T.I.S. project. This project will have a significant effect on the efficiency and the method of work in the Internal Revenue departments, and will bring a dramatic change in the way the income tax departments treat tax payers.

Before we discuss the services we shall give to the representatives of the tax payers - namely Certified Public Accountants and tax consultants - we wish to give you some preliminary information about the methods of work at the I.R. departments.

Because of historic difficulties, and complexities of the Israel Tax law, I.R. delegated its authority and responsibilities and the tax payers to the C.P.A. and tax consultants. As a result of this set up most of the tax payers do not work directly with the tax authorities, but through their hired representatives. Nearly 80% of the tax payers are being represented nowadays by these people and 95% of the tax income is being collected from these tax payers.

Today, the tax payers population and their representatives are being served by hundreds of clerks in I.R. departments. The basic idea in this project was to allow the C.P.A.'s direct access from their local P.C.'s to I.R. computers and to give them the basic services that before, I.R. clerks had to deliver them. The main obstacles that we had to overcome were:

1. Information security problems
2. Communication problems - the solution we were looking for had to be hardware and vendor protocol independent
3. Maintenance problem
4. Human problems - opponents to the new system because of conservatism.

Now, after we have solved the technical and human problems, and finished a one year experiment with 30 big C.P.A. and tax consultants offices, we have already connected 200 more. Until the end of 1988 we will connect 2000 more working stations.

The services we will give to the tax payers representatives are:

1. Inquiries:
i.e. : - state of account of tax payer
- personal record information

2. Data Entry:
i.e. : - changes in personal records such as addresses, identification codes, occupations, etc.

3. Calculations:
i.e. : - calculations of monthly or annual tax liabilities

4. Payment orders

5. Information retrieval of:
i.e. : - Tax laws
- Court decisions in tax matters

All these transactions are being done and will be done from the CPA's office through simple dialing connections. The representatives of the tax payers will pay for this service. The payments will give the Ministry of Finance a return on its investment in 4 years and reduce staff by 15%. The extension of this application to computerized tax payments will bring further significant financial savings.

The computerised tax payments process will operate as follows: At the beginning of a tax year, the tax payer will give permission that allows automatic debit of his bank account for tax payment.

The tax payer's representative transfers every month a centralized order, from his office computer through the communication network to the I.R. computer. The payment order includes all the relevant data concerning the tax payers involved. The I.R. computer sends a message to the relevant bank, it debits the tax payer's account, in the computer or the relevant Bank and credits the account of the I.R.

The Bank confirms the payment order and the representative gets immediate approval. It is estimated that, once completed, this process will save the Government millions of dollars a year in bank commission payments alone.

The benefits are as follows :

The P.T.I.S. project will bring about a dramatic change in I.R. systems and methods of work. There will not be any more need of clerks for the simple bureaucratic work. The tax clerks will deal with files of tax payers which have large tax collection potentialities. Furthermore, the tax system is going to be more updated and more accurate. (See appendix 6).

3. Judiciary project

In this project, we plan two major phases. In the first phase we will set up computer centres in the various branches of the Ministry of Justice. The computer centres will be connected one to the other via on-line applications. In the second phase, the computer centres will be connected to the outside world, allowing lawyers to connect to the local computer center and make inquiries or retrieve judicial information, connected to their clients. This project will improve working methods and increase productivity, it will enable single data entry, all over the system.

Data will be transferred by the communication network to the desired computer. These projects, when completed, will bring about a dramatic reduction in the secretarial work force and will shorten the elapsed time from the time the file is submitted to the court until it comes before a judge.

SUMMARY

This Master Plan which we tried to present to you today we believe will bring about a change in the behaviour and way of functioning of all government offices in all the fields mentioned and will reduce the bureaucracy, and economic costs.

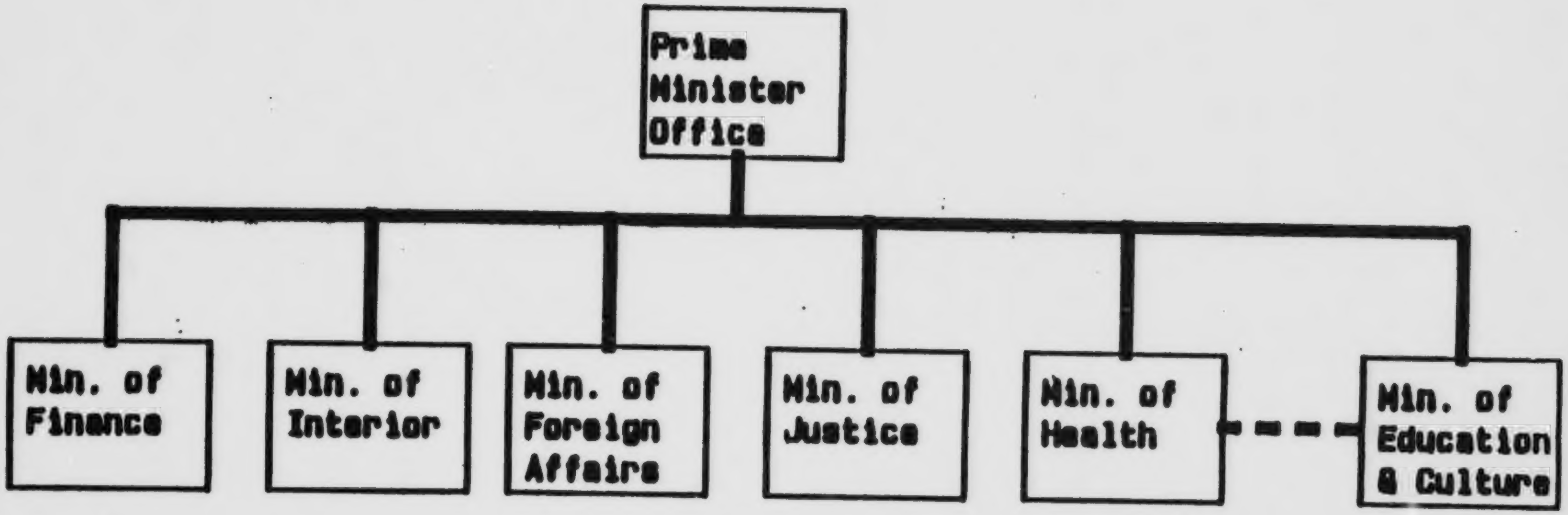
The characteristic of our actions in implementing these plans, namely, decentralisation of authority and responsibility, while maintaining and operating supervision and control, enables coordination and cooperation with all ADP center offices and their managers.

The process of friendly communication which was built in the last few years between all involved enables each and every side involved to express themselves in full. Negociations, recipriority and friendly exchange of views accompanied by goodwill enables us to find the right technological solution - within available funds - suitable to the people, environment and the public at large, when needed.

The Master Plan implementation will elevate IT in the government and thus increase efficiency, give better services to all the decision makers, bureaucracy and the general public, and at the same time reduce government costs.

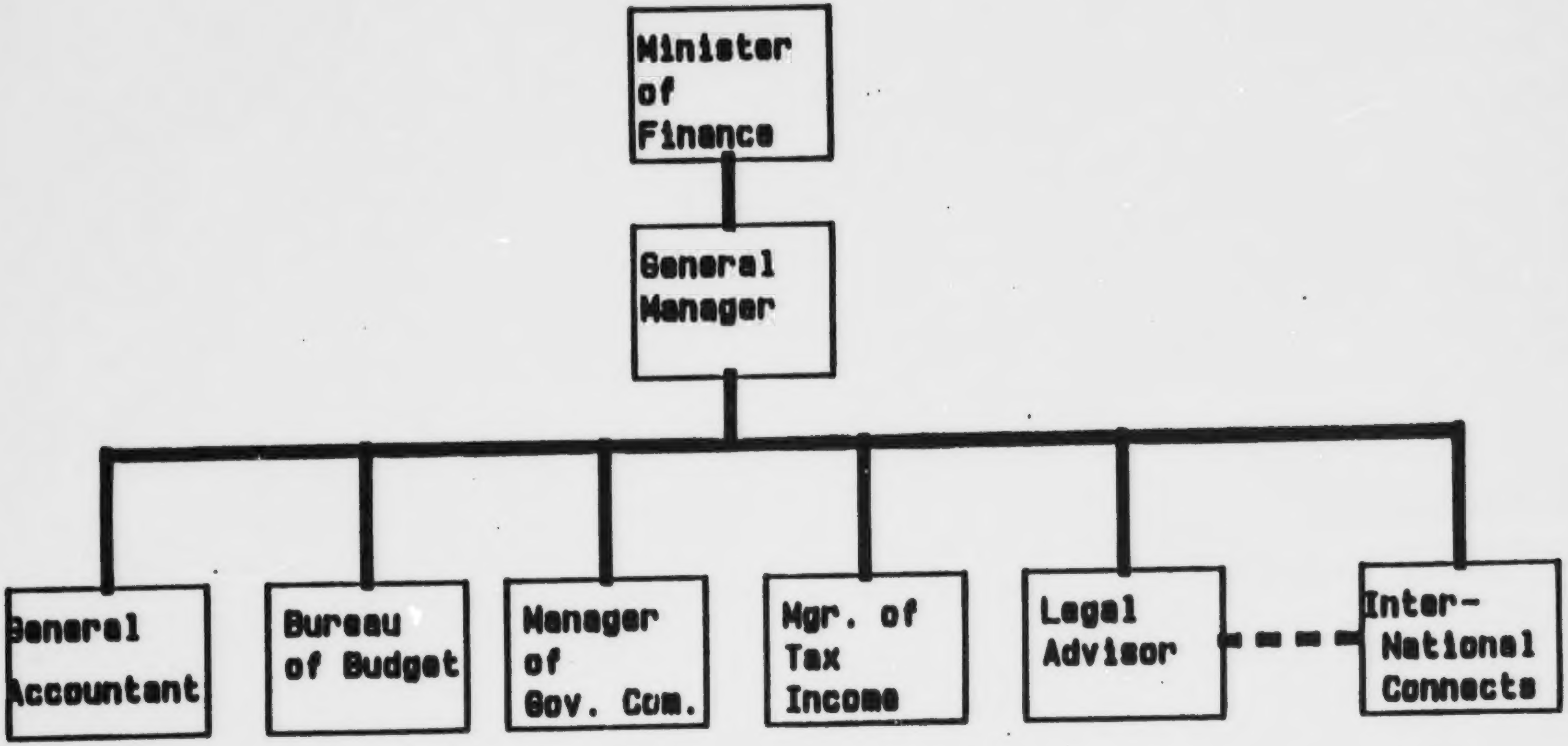
APPENDIX 1

Government of Israel


Prime Minister Office
Min. of Finance
Min. of Interior
Min. of Foreign Affairs
Min. of Justice
Min. of Health
Min. of Education & Culture

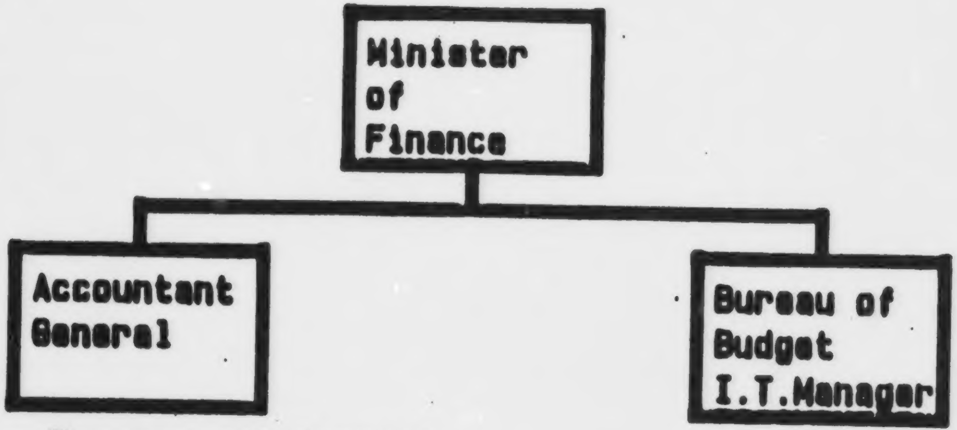
APPENDIX 2

Ministery of Finance


Minister of Finance
General Manager
General Accountant
Bureau of Budget
Manager of Gov. Com.
Mgr. of Tax Income
Legal Advisor
Inter-National Connects

APPENDIX 3

I.T. - Management in Ministry of Finance



Minister of Finance

Accountant General

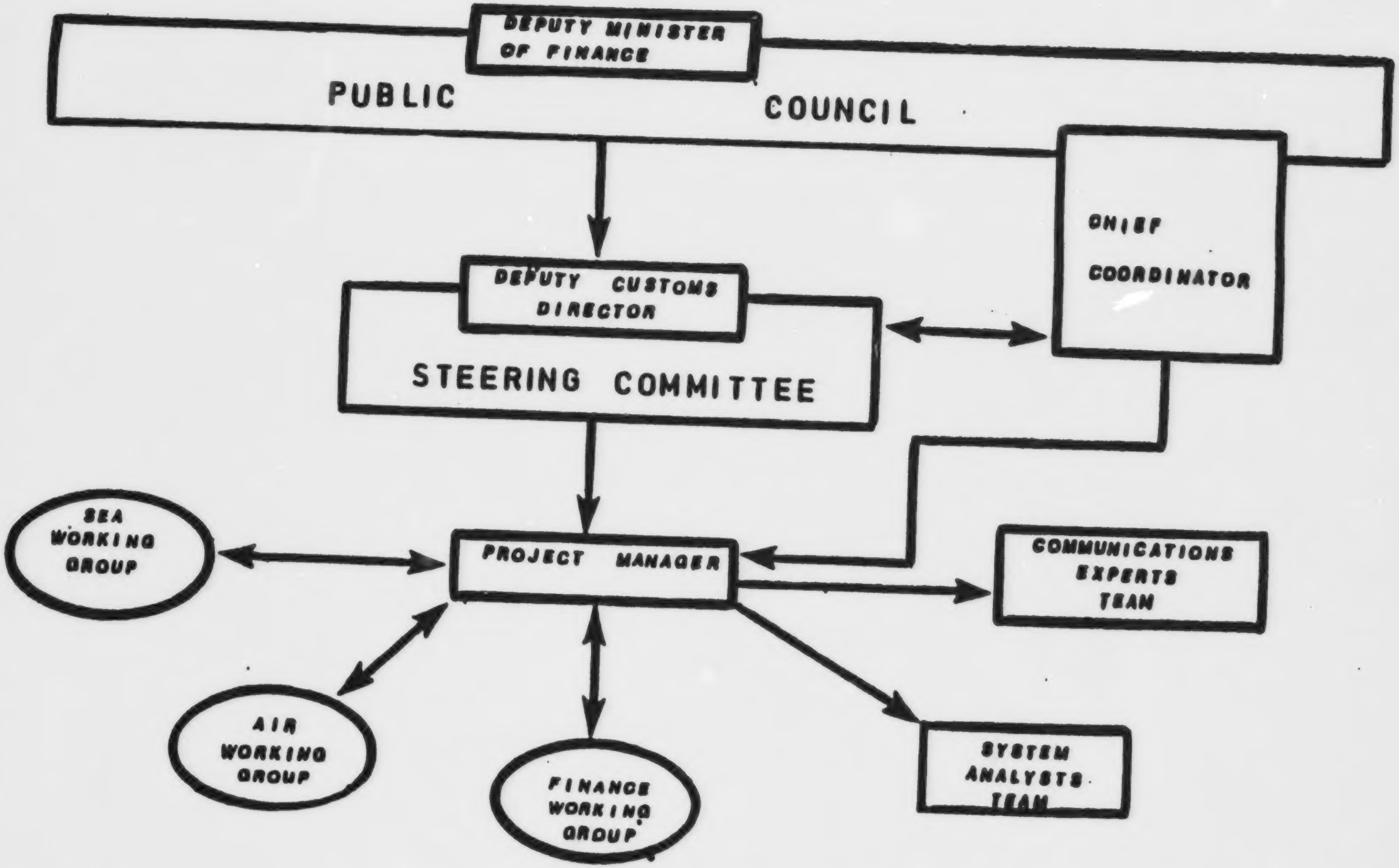
- Procurement Commitee
- Central Bids.
- Control & Audit through Ministry Accountants

Bureau of Budget I.T.Manager

- Master Plans
- Annual Plans
- Budgeting
- Project Management
- Hardware & Software Testing

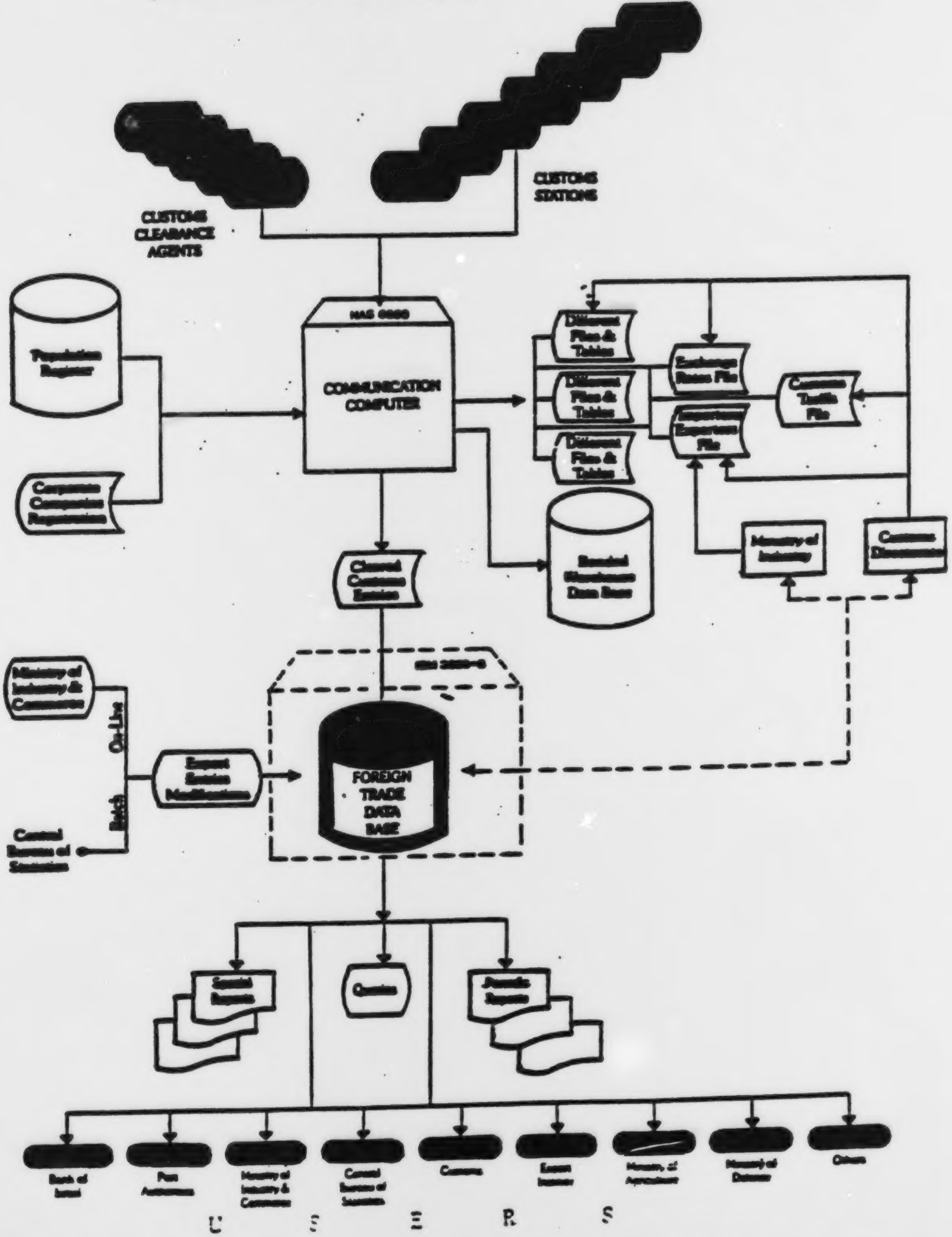
PPENDIX 4

I,F.T.S ORGANIZATIONAL STRUCTURE


DEPUTY MINISTER OF FINANCE
PUBLIC COUNCIL
CHIEF COORDINATOR
DEPUTY CUSTOMS DIRECTOR
STEERING COMMITTEE
SEA WORKING GROUP
PROJECT MANAGER
COMMUNICATIONS EXPERTS TEAM
AIR WORKING GROUP
FINANCE WORKING GROUP
SYSTEM ANALYSTS TEAM

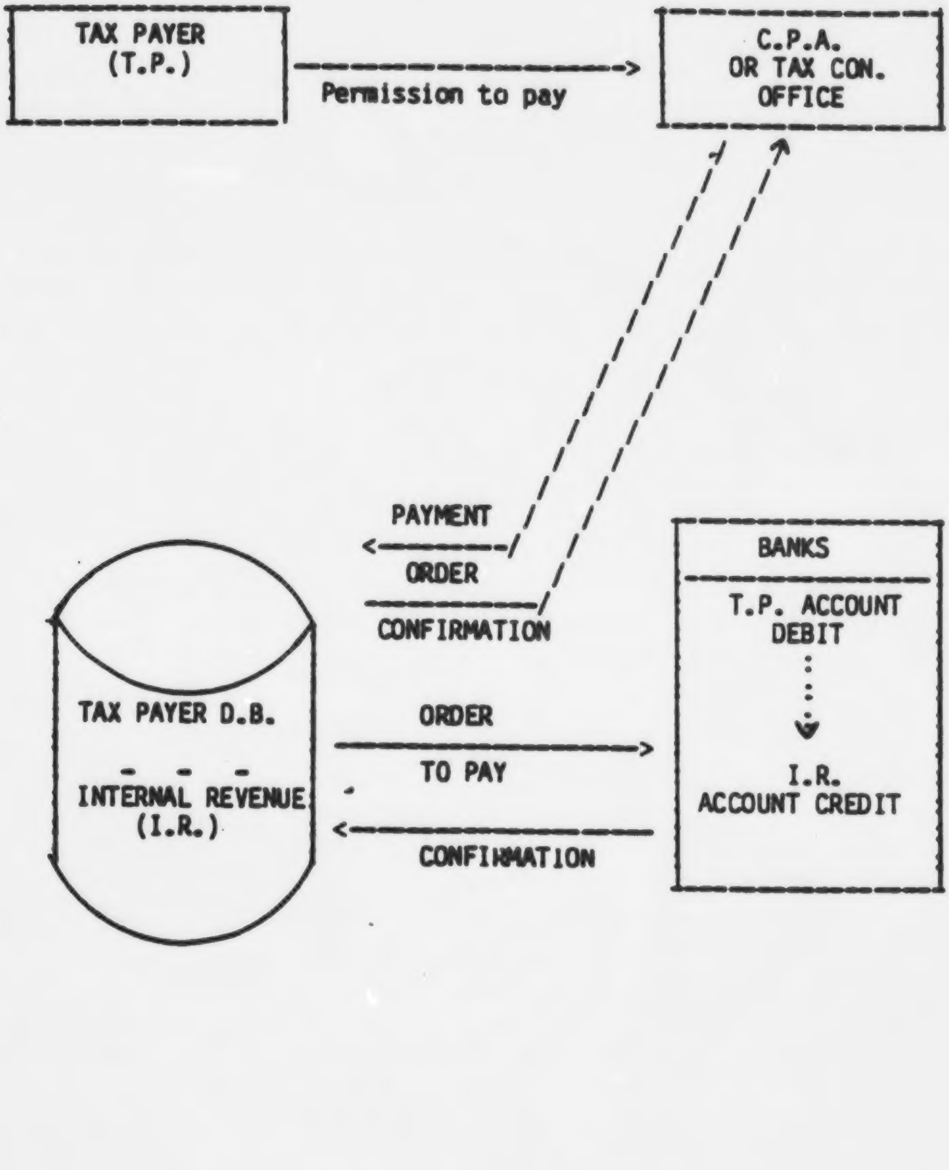
APPENDIX 5

MAIN COMPUTER CENTRE (MALAM SYSTEMS)


CUSTOMS CLEARANCE AGENTS
CUSTOMS STATIONS
NAS 6600
COMMUNICATION COMPUTER
Population Register
Corporate Companies Registration
Different Files & Tables
Different Files & Tables
Different Files & Tables
Exchange Rates File
Customs Tariffs File
Importers Exporters File
Bonded Warehouses Data Base
Ministry of Industry
Customs Directorate
Cleared Customs Entries
Ministry of Industry & Commerce
On-Line
Batch
Export Entries Notifications
Central Bureau of Statistics
FOREIGN TRADE DATA BASE
Special Reports
Queries
Periodic Reports
Bank of Israel
Port Authorities
Ministry of Industry & Commerce
Central Bureau of Statistics
Customs
Export Institute
Ministry of Agriculture
Ministry of Defence
Others
U S E R S

APPENDIX 6

COMPUTERIZED TAX PAYMENT


TAX PAYER
(T.P.)
Permission to pay
C.P.A.
OR TAX CON.
OFFICE
PAYMENT
ORDER
CONFIRMATION
BANKS
T.P. ACCOUNT
DEBIT
I.R.
ACCOUNT CREDIT
TAX PAYER D.B.
INTERNAL REVENUE
(I.R.)
ORDER
TO PAY
CONFIRMATION

ON A LOCAL ECONOMIC INFORMATION SYSTEM

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Division Chief, Engineer
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I. THE NATIONAL ECONOMIC INFORMATION SYSTEM

A national economic information system is a multi-leveled feeback control system. According to the cybernetics concepts, a national economic system in a country is a feedback control system. As to the national economic activities, the controller is the nation's supreme administration which is a decision-maker. Before it decides on the adjustments to be taken and on the control measures, methods, scope, and the effect expected, it must refer to the substances controlled, i.e. the current situation of the whole social economic activity of the national economy, the goals it expects the national economic activities to reach (e.g. the growing speed, profit and effect quota), social and economic environment both inside and outside the country as well as other binding conditions. The feedbacker here obtains the information about situation of the national economic activities, and then conducts adjustment and control in time.

Our national economic system is also a feedback controlling system. But to a country like ours in which the planned commodity economy is put into practice, this system has many differences compared with the nations practicising pure commodity economy. The adjustments and control our nation conducts for the national economy is done on various levels. On the national level there is the State Council, total management departments and special agencies; in the entire country, there is the national level, provincial (municipality), city (prefecture) level. Judging from the degree of the new economic operating scheme, "Nation adjusts market and market guides enterprise", this system is also a multi-leveled economic control system. Every level in the system is controlled by a higher one (acts as a controlled substance) while it controls a lower one (as a controller). It receives information which is feedbacked, and at the same time it has to feedback information to a higher-level (sub)system. This forms a complicated multi-level feedback control system.

Every level of this system is an economic control system. There are several provincial (municipal) economic control systems and more city (prefectural) systems. That is to say, the main system consists of many branch- and subsystems. Those are the substances which are both relatively independent and interrelated. Thus a very intricate, multi-leveled feedback economic control system is formed in length and breadth in the country. Inside the system, nation adjusts market, and then market guides enterprise, reaching "the scheme of internal unity of planning and market".

II. THE LOCAL INFORMATION SYSTEM IS THE INTERMEDIARY OF THE NATIONAL ECONOMIC INFORMATION SYSTEM

The multi-leveled control and feedback characteristics of the national economic controlling system brings up two problems within the system operation. First, there is probability of serious system time-delay due to so many links between control and feedback. If time-delay exceeds a certain limit, the system will be out of control. Secondly, because of the numerous links which are constantly feedbacking, levels in the entire system will greatly influence each other. This may lead to incorrect feedback and failure of the system control, finally to disorder of the operating system. We have occasionally experienced such a case.

To solve these two problems, we should ensure, first of all, correct, timely and well-informed feedback of information; second, adjusting and controlling measures and methods should be accomplished properly and effectively. Both are not so easy. The former is the base and premise for solving problems. Only on this base, the measures and methods, and more importantly, to what extent and how they are used, can be decided. This is the issue to be discussed here. The latter is also very important, but will not be discussed here.

To ensure efficient operation and effective adjustment and control of the national economic controlling system, the feedback information must be correctly, well and timely informed. Because of the constant change in social and economic phenomena, the dynamic feature is one of the important features to this kind of information. Thus this kind of feedback information relies only on statistical data. The economic information system will strive to solve these problems, to work hard on the dynamic feature of information. Economic information covers not only the dynamic feedback information from the objects controlled, but also adjusting and controlling information delivered to the objects controlled from the decision-making departments (controller), as well as information on environment and regulations of the system operation.

Information is an objective reality in the national economic control system. The information structure of the economic information system is the reflection of the national economic system in informational space. The fact that the national economic system is a complicated multi-leveled controlling system determines that the economic information system be the same. It also has a certain number of branches and subsystems within which the flow of information is crisscrossed and the situation is intricate.

Reforms on both the political and economic systems currently carried out in China makes the special agencies of the State Council transfer their direct control to macro sector (department) management. These agencies will not directly face market and enterprise. On the contrary, related departments in provinces (municipalities) and key cities will do so to meet the situation. So all provincial (municipal) and key cities' information systems will be more closely connected or interrelated with markets and enterprises than those which serve the departments of the State Council. Of course, such a case is exceptional for departments which still adopt vertical management systems, e.g. banks and railroads etc. In fact, the provincial (municipal) and key cities' economic information systems act as an intermediary (relating to both higher and lower levels) inside the entire national economic system. While they delivered the national decision makers' adjusting and controlling information to all operating parts of their own systems, they feedback the developments of their systems' operations to the national decision-makers who again determine the measures for methods adjusting and controlling upon the situation of the systems' operation.

This function of intermediary by local information systems will be more and more obvious with the development of reforms of the political and economic systems in our country. We should fully understand it while constructing our economic information system.

III. CHARACTERISTICS OF THE LOCAL ECONOMIC INFORMATION SYSTEM

The local economic system is the main part of substance controlled by the national economic system. Its activities have to be regulated by and bound to the national system. At the same time, the local system takes lower-levelled economic systems, markets and enterprises as the substances controlled by itself. That is how local systems act as intermediaries in the national economic system as a whole. The characteristics of local economic systems determine its function of intermediary in the national economic information system, and this function determines its own status and features (general features together with special ones because of different geographical environment) in the entire system.

The local economic information system is primarily the part of the national economic information system, which directly faces the markets and enterprises or, as we say, is an interface linking the national economic information system with the market information systems and enterprise management information systems.

The local economic information system, especially of key cities (prefectures), is the joint combining macro economy with micro economy. There are macro and micro information in the information structure. The information system should serve macro economy and guide micro economy, both tasks should be well-fulfilled. Moreover, the lower the level of the subsystem is, the larger the quantities of micro information it has and work on guiding micro should be done even better.

The local economic information system faces vast markets and plenty of enterprises and production managing units. Their activities produce huge amounts of economic information, which is a source of information for the system. Fully developing these information resources is an important task and characteristic of the local information system.

Because local economic information systems are close to the information sources from which information has a great deal of dynamic features, we must keep observing and monitoring these dynamic features of the source in order to guarantee the information to the entire system. A large part of the work in collecting and delivering information from these sources is done manually, thus a manual information system plays an important role here. It is another significant feature to combine a manual information system closely together with a modernized one.

When we work in the designing and implementing of local information sytems, we must take into account the fact that our country's bases for contribution are still backward, so are the communication networks and related equipment. Such an awkward situation cannot be expected to change in a short period of time.

IV. MAIN PROBLEMS FOR CONSIDERATION IN DESIGNING AND IMPLEMENTING A LOCAL ECONOMIC INFORMATION SYSTEM

We should pay further attention to the characteristics of local economic information systems when we design and implement the system. This is both helpful and very important to speed up the construction of the system and to give full scope to the system's efficiencies.

The local economic information system, which itself also contains subsystems and branches, is a part of the national economic information system. It is a large-scale complicated social system. Its design should be basically similar to that of the national system. The methods of analysis for national systems should be used here again, especially to analyse the local system's objective, environment and structure.

When we work on systems design and implementation, we should lay stress on macro and micro economies, that is to say, the system should both serve the macro decision making and guide the micro economic activities. Some subjects on micro economy should also be stressed in the designing of databases and application systems; e.g. data banks on micro economic aspects should be produced.

The local economic information system faces markets which occupies a key place in the commodity economy, so an integrated market economic information system should be built up within the system in order to reflect the situations of markets. Then it is an important task for the local economic information systems, especially for systems of key cities, to build up market information systems in the work of system design and implementation.

We must work hard on information sources to develop information resource and ensure to provide correct information in time. As mentioned above, the local system is close to the information sources, several key information sources, for example, markets, shops, the Customs, important enterprises, etc., should find and keep direct, constant "hot line" relations. This will keep the dynamic feature of information collected, monitor development in detail of the economic life and activities and feedback information to higher level systems in time.

Since local economic information directly faces markets and enterprises, it will receive large quantities of consumers, information input and output, information inquiries and collections. So we must take into more consideration the system's hardware and software interfaces in the system design for the benefit of the flow of information throughout the market information system, enterprise management information system and information sources.

Still we should emphasise the manual information system in our work on designing and implementing of local information systems. With a rather long period of time, information will have to be collected through manual methods. Modernized information systems and manual ones will exist together for a long time, and transferring from manual to complete modern methods will be a long and gradual process.

The environment of communication for local economic information systems is still not up to the mark, with great difficulties for data transmission. Viewing the current situation of our country, we cannot expect that will be changed a lot in the near future. It is impossible for local economic information systems in many areas to realise the modern methods of data communication in a comparatively long period. Instead data can only be transmitted or delivered through teleset line in middle or low velocities, even by manual data disk delivery. Considerations should be taken into account in the work on system design and implementation.

Since the local economic information system is an important part of the national economic information system, we should have a good understanding of the characteristics and features of the local economic information system, and do our best to fulfill the work on system design and construction, to ensure the integration, timeliness and accuracy of the economic information collected. This will make our national economic information system a barometer for the operation of the national economy system, to ensure healthy development of the national economy.

WORKING GROUP C

INTERDEPARTMENTAL STANDARDS CONCERNING DATA, SOFTWARE AND HARDWARE

Chaired by:
Mr. Owe Salomonsson

Members:

Dai Yunwu
Ding Jixanxun
Magatte Diouf
Torsten Frank
Bingzheng Gong
Awad Hallouda
Hao Li
Kheng Hwa Ko
Ni Xiaoyan
Shafeek Saleeb
Jianping Shang
Su Zushun
Wang Zhenji
Wu Benzhong
Sam Suharto
Xiong Jiahui
Ye Fang
Yu Bingjun
Zhao Yanhua
Zhou Qifeng

WORKING GROUP C REPORT

1. INTRODUCTION

1.1. There are many case histories where public administrations have reaped immense benefits from interdepartmental standardisation of data and suffered greatly when such standardisation is ignored. For example, a recent French initiative in data standardisation is expected to save 30,000 man-persons of work and 6 billion francs. In contrast, the US Forest Bureau has to rebuild its information systems because its current systems have great difficulty in sharing data due to non-standardisation (1). The interdepartmental standardisation of data, software and hardware is therefore of urgent concern to public administration and national economic management.

1.2. While many of these problems have existed since time immemorial, they have assumed tremendous importance with the recent rapid advancements in information technology. In particular, the proliferation of computer systems, especially microcomputers, and the resulting information explosion have made interdepartmental standardisation of not only data, but also software and hardware, a pressing issue to be addressed by public administrations.

2. PROBLEMS OF LACK OF STANDARDISATION

The problems of lack of data standardisation are :

a) Repetitive collection of same data by different departments. This is not only costly, but the data more error-prone and more likely to be inconsistent between departments.

b) Inability to collate and aggregate data obtained by different departments for analysis, statistics compilation and modelling.

c) Difficulty in using data from administrative and transaction processing systems for input into management information, decision support and statistical systems.

d) Difficulty in networking computer systems of different departments to facilitate data exchange and operation of inter-organisation systems

e) Inability to use the same application software in different departments with dissimilar hardware, thereby incurring higher cost.

f) Need to retrain systems and user personnel when they are transferred to a department with a different computer environment.

3. DATA STANDARDISATION

3.1. Public administrations, in both developing and developed countries, should take concrete action, or if they have done so, intensify their efforts, on data standardisation. The later this is postponed to, the more expensive it will be to implement standardisation in future. This is because all administrations are presently spending resources on developing and operating information systems, whether manual or computerised, thereby getting more deeply entrenched in their current systems based on non-standardised data.

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(1) As described in the paper "The General Conception of Standardisation of the State Economic Information System of China" by Zhou Qifeng, Yao Shiquan and Zhou Sung published in these proceedings.

Implementation

3.2. The epxerience on data standardisation has thus far been confined to selected government functions such as statistics compilation, land use, etc. Few countries have demonstrated a succcessful model for comprehensive data standardisation in public administration. Over the last decade, DFD has developed a set of guidelines in this area known as Government Data Networks. These guidelines have been successfully tested in the planning and implementation of government data systems in Senegal. The experience in Senegal is documented in Annex A.

3.3. In drawing up national standards, public administrations should first consult currently available international standards such as those published by the UN Statistical Office and other UN agencies and the International Standards Organisation. Some of these standards are flexible enough to be tailored to meet national requirements. Wherever possible and feasible, the international standards should be adapted and adopted for national use. This will obviate "reinventing the wheel" in setting standards for national public administrations. Equally important, international exchange and collation of data and comparison of statistics will be greatly facilitated.

3.4. Public administrations should also ensure that the data standards they set should be flexible enough to cater for future changes and expansion. Otherwise, expensive modifications will need to be made frequently to data collection and processing systems whenever the standards have to be changed to meet new requirements.

3.5. The data dictionary, especially a computerised one, is an extremely useful tool to help in the data standardisation process and the dissemination of data standards. Public administrations should seriously consider the setting up of a data dictionary when they commence their standardisation initiative.

3.6. Due attention should be paid to designing administrative and transaction processing systems to ensure that the data in such systems can be used for national statistics compilation and decision support purposes. Such data should be consistent with the national standards where they exist.

3.7. A much greater degree of co-ordination and co-operation between departments is needed to effectively implement data standardisation. Data standardisation stresses the principle of collecting data once and at the source as far as possible. This will mean that some departments will have to collect, and be responsible for the accuracy of data which are of no use to themselves but are needed by many other departments.

3.8. Great publicity is needed to create awareness among public administrations in the importance of data standardisation and availability of the various international standards. It is also essential that appropriate education and training in the application and implementation of standardisation be available.

3.9. In countries where the dominant language of public administration is not English, the main language in the information technology field, special problems arise, for example, the standardisation concerning input, processing, output and computer-to-computer interchange of Chinese characters (please see Annex B). In such countries, standardisation on the issues peculiar to their language should be accorded high priority as all other systems to be developed in the country will be affected by the standards.

4. SOFTWARE AND HARDWARE STANDARDISATION

4.1. Unlike data standardisation, software and hardware standardisation is not vendor independent. The short history of the computer industry is characterised by different vendors offering numerous software and hardware products that are incompatible with each other. As a result, users have found it very difficult to standardise on software and hardware.

4.2. The emergence and implementation of international or industry standards for software and hardware has been painfully slow. However, the computer industry has made good progress recently in adopting UNIX as the industry standard operating system software. While there are still problems to be solved in this effort, it nevertheless holds considerable promise in standardising system and application software in the longer term. Also worth noting to the growing acceptance by vendors of the ISO's Open System Interconnection Standards for computer communications.

4.3. Meanwhile, public administrations should not sit back and wait for the international and industry standards to be adapted and implemented. In the meantime, some standardisation can still be made in terms of the restriction of the types of software and hardware to be used in public administrations.

4.4. A "free for all" approach allowing an administration to use any number of makes of computers is certainly undesirable. It can give rise to endless problems such as complexity in systems management, data communication difficulties, maintenance issues, etc. On the other hand, standardisation on one hardware and software type is also as undesirable. The public administration will be locked in to one vendor and can be at their mercy in terms of pricing, service, support, product enhancements, etc. A middle of the road approach should be considered whereby the hardware and software is standardised to a few types which can, as far as possible, communicate with one another. This is particularly relevant for governments which are about to embark on computerisation in a large scale as many software and hardware have not been installed. For example, China is planning to restrict the operating system and hardware to a limited number of makes each for mainframes, mini-computers or micro-computers to be used in the country as far as possible.

4.5. It should be emphasised that standardisation should go beyond operating system software to include other software like data base management systems, system development tools, data dictionaries, application programs (e.g. re-usable modules). In particular, the standardisation of data dictionary can accelerate the adoption of data standards by different departments. Different departments can then easily and inexpensively install a common data dictionary of standardised data during system development.

4.6. International organisations like ISO and the UN can play a greater role in quickening the pace of international and industry standardisation on software and hardware. Further, large national institutions and public administrations should leverage their massive buying power to press the computer vendors to move towards systems compatibility and conformance to international and industry standards.

5. STANDARDISATION AGENCY

5.1. Data, software and hardware standardisation is a multi-disciplinary effort involving many departments in public administration. It is therefore essential that a central agency be assigned the responsibilty for the co-ordinated, formulation and enforcemnt of such standards.

5.2. There are many joint projects between countries and international organisations which involve computerisation. In some of these projects, little attention is given to the issue of data, software and hardware standaridsation efforts in the country. The problem is often compounded by multiple international organisations working on many separate projects with different departments in the same country. The respecting national standardisation agencies and international organisations should ensure that such joint projects support the data software and hardware standardisation policies of the countries concerned.

6. RELATED STANDARDISATION ISSUES

6.1. To realise the full benefits of interdepartmental data, software and hardware standardisation special attention should be paid to addressing the following issues :

a) Effective management of the standardisation process such as documentation standards, standards dissemination, change control procedures, conformance testing and organisational structure

b) data interchange standards to define the message, syntax and protocols for computer-to-computer exchange of data

c) Quality control standards for data collection, software quality testing, conformances and compatibility testing, etc.

d) Software engineering standards to improve the productivity of the software development process

e) Guidelines for evaluating the costs and benefits of computerised information systems.

ANNEX A

The Senegalese Government Data Network (GDN) is built around three basic entities which are:

- Physical persons
- Legal persons (enterprises, establishments, associations)
- Land properties

In the past, data related to each of these entities were collected, utilised, processed, memorised and disseminated by the different Governmental Agencies in the process of normal administrative work. These activities often generate duplication of data collection and storage and inconsistencies of data between different departments.

The project carried out by the Government of Senegal with the assistance of DFD aims to develop standards in the definition of the data and in the procedures for the collection and updating of these data.

1. Data Dictionary

For each entity, the data dictionary defines:

- the identifier

- its precise definition accepted by all affected departments

- the format, the definition and the update procedure of the basic entities

- 2 or 3 data items for each major user department.

2. Creation of the Registers

For each basic entity, an agency has been designated to be responsible for the creation and the administration of a central data register. These agencies are :

- the land registries
- the Statistic Bureau for legal persons
- the Ministry of Interior for physical persons

Each register contains all occurences of the given entity and can be assessed by each user department.

3. Update

An update can be the creation of a new occurence or the deletion of an existing occurence or the modification of its data values.

The basic data items are updated by the agency in charge of administrating the register while the specific data items specific to each department are updated by the department concerned.

4. Example : Land Data Dictionary

Identifier : plot number

Basic Data : plot coordinates

- area
- plot value

Specific Data

a) Housing Department

- legal rights and encumberances
- number and date of building permit
- building value

b) Registry of Titles and Deeds

- mortgages
- identity of the owner

c) Land Registry - Land polygon co-ordinates

Implementation Status

The following tasks have been completed for all the three entities:

- Construction of the data dictionary
- Definition and implementation of the update procedures
- Creation and initialisation of the data base structure for the data register.

The most time-consuming tasks are related to the actual gathering and loading of the data bases. The status is as follows :

- Physical persons

Gathering and loading 60% completed

- Legal persons

Gathering and loading of the data base completed for all the enterprises with modern accounting practice.

- Land property

a) Gathering of 15% complete
b) Loading of the data base limited to pilot area.

CONCLUSION

The main advantage of the system is that each user department benefits from the registers more than its contributor to the register. The user is therefore highly motivated to undertake its responsibility in updating the specific items in the central data register.

ANNEX B

STANDARDISATION PROBLEMS IN CHINESE INFORMATION PROCESSING

Areas for Standardisation

The Chinese characters are ideographic ones. Their numbers are large and shapes are complex. Therefore they can only be represented by multiple bytes instead of a single byte. There exist at least four types of code:

a) input (entry) code
b) inner code
c) output code (font code)
d) exchange code (during communication)

Problems of Standardisation of Chinese Code

The two main problems relating to the standardisation of Chinese character code are :

a) difficulty in making simple, direct relationship between these codes

b) ambiguity problems in combining these codes with ASCII, EBCDIC etc. in a same environment

Status in China

It has been widely accepted that all other kinds of codes should have one to one relationship (mapping) with GB2312 (China National Standards of Interchange Code - basic set) if they are to become national standard codes. Several font codes have been published as China National Standards (GBs) and inner code GBs are expected within 3 years.

Many researchers are studying the ambiguity problems related to combining Chinese character codes with established codes like ASCII. For example, the paper entitled "Putting Chinese Information Processing Systems into OSI World" by Ding Jianxun and Zhang Gendu from Fudan University, Shanghai, suggests a method to put the Chinese computers into OSI network environment consistently and compatibly with other Western information processing systems.

WORKING GROUP D

EX-POST EVALUATION OF INFORMATION SYSTEMS

Chaired by:
Mr. Du Lian

Members:

Gordon Bridger
Rod Dobell
Dong Zhenjiang
Shakuntala Kuruppu
Du Lian
Lui Degang
Masihur Rahman
Gaylord Worden
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Xie Yansen
Xu Kongshi
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Yan Yonggon
Yuan Danhong
Zhang Liang

INTRODUCTION

The note circulated by the Chairman identified two broad purposes to be served by an information system in public administration:

- improved decisions
- improved implementation and program delivery.

It also identified both economic and social benefits, and speculated that for developed countries technology may follow economic requirements, while in developing countries basic social purposes may be served through the transfer of existing technologies. Particularly in the latter case, the major benefits may be through education and training, not only the training of the suppliers of the information services, but even more important, the education of the users, including policy makers and enterprise managers. The introduction of effective information systems thus can not only provide better information, but also change old habits of management and decision-making, and force reorganisation toward more effective structures.

The discussion group therefore considered the purposes to be served by the State Economic Information System, and then the possible approaches to evaluation of such a system.

PURPOSE OF SEIS

On the question of purpose, the Chairman and his colleagues suggested that the primary purpose of the State Economic Information System was not to provide a statistical reporting system designed to yield a description of China's changing society (or social self-awareness), and it was not principally to provide macroeconomic forecasting models or simulation capabilities, although these would be a part of the work. Rather the purpose is to provide background for specific policy decisions, on market developments, major investments, the location of enterprise, or policy with respect to major export deals and joint ventures, for example. The principal users thus are the State Planning Commission itself, major enterprises, and individual economic agents as well as other government agencies and ministries.

The importance of special applications in individual ministries or for special projects of the State Planning Commission was heavily emphasised. The need to develop information systems enabling close monitoring of changing conditions in goods markets - production and prices - and in labour markets - employment, wages, unemployment, labour demands, job vacancies, and so on - was stressed as a particular challenge during this period of economic reform and rapid transition in the economy.

Plans for a pilot project to develop an information system for monitoring prices were outlined, and seen as particularly important in light of concerns about growing inflationary pressures in China.

EVALUATION OF SEIS

The group therefore turned to consider how to evaluate success in meeting these goals and serving these different users. The note circulated by the Chairman suggested that the literature contains reference to four types of indicators :

- productivity
- efficiency

- effectiveness
- benefit-cost analysis

for use for this purpose.

Discussion ranged over a wide variety of considerations, but came to the following practical conclusions.

- There exists a variety of operational performance measurement systems to track productivity and efficiency in the provision of information and the management of information systems - but these are not the most important or significant considerations in evaluating information systems, particularly in the earliest stages of their introduction, when the important consideration is to achieve wider utilisation. Efficiency considerations will become more important in later operative and maintenance stages.

- At the other end of the scale, a full benefit-cost analysis, with some plausible measure of the value attaching to the improved decisions resulting from a better information system, is simply not possible in practice. The value of the information system in terms of social benefits and improved economic performance will simply not be identifiable for purposes of ex post evaluation in a benefit-cost framework.

- Thus there remains the approach to selected indicators of effectiveness for evaluating elements of SEIS. The group suggested several considerations:

i) Orientation to the user's needs, not the designer's criteria, is fundamental. It is more important to have results from the economic information system at a time and in a form where they will be used than it is to be elegant or comprehensive or fully integrated.

ii) Reasoning from the analogy of economic information services like DRI or WEFA in the U.S., it is clear that the market test of profitability provides important information about effectiveness and client satisfaction, but these market tests will not be sufficient for SEIC. Nevertheless, the possibilities for some revenue dependency (or cost recovery) should not be overlooked. Some users can (and should) be charged for information services and special studies, and this will help to demonstrate the value attached to the information system. The possibility of "spinning off" independent economic information service enterprises is one that deserves serious exploration as demands for these services become more clearly established.

iii) Even without relying on "market tests", the same kinds of questions about user acceptance can be asked for evaluation purposes:

- are there growing numbers of users seeking information from the Centre?

- is the system providing information in a timely manner?

- is coverage of areas of interest increasing?

- is management of the system resulting in valuable training of users as well as suppliers?

- does the information system have something interesting to say about critical social questions -e.g. impact of demographic structure on demands for state service; impact of changing world trade patterns on domestic production structures and investment requirements; links from environmental policy and resource use to economic decisions? Are there major failures in anticipating important information needs of this sort?

- a growing number of requests for special applications is perhaps the most direct indicator of effective performance. Are such applications increasing?

- the ability of the SEIS to respond helpfully to requests for special applications or special studies will be an important test.

CONCLUSIONS

Thus the conclusions from the discussion Group D are perhaps too simple. They suggest that ex post evaluation of the SEIS should not be carried out primarily by system design teams or system design criteria, nor exclusively by the market or the user, but according to a set of pragmatic and practical tests of usefulness in application. These should reflect the importance of good relations and growing reciprocal interactions with three groups of users: Planning Commission; other Ministries or provincial or local governments; enterprises, both state and market. These will be the users of special applications, and the last two groups will also be the suppliers of administrative and survey data.

It may also be noted that ex ante evaluation is also important in considering investment in extending the SEIS, and managing its operations - what cost to get faster reporting? what cost for greater coverage? greater uniformity? decreased size of revisions? improved accessibility for users?

Finally, it can be noted that at this stage investment in an information system like SEIS will inevitably be a matter of faith in the potential applications and the value of improved information. It will be technology-driven in large part, because potential applications are not yet clearly perceived by many users. An additional important part of the impact will be, like economic reform itself, in opening up the economy and enterprise management, as well as government administration, to the pressures and the experience of the outside world.

Related roles for SEIC also must be emphasised in providing:

- common standards for documentation of Ministry information systems

- specifications for data collection - handbooks; uniformity (one dimension of evaluation is success in achieving uniformity)

- specifications for equipment procurement

- advice to ministries, government agencies, enterprises.

In general, these tasks fit within an overall orientation of attempting to achieve concrete applications as continuing partial realisations of the general system, coupled with development of standards sufficient to ensure that these interim prototypes cumulate to an integrated system eventually. In particular, the possibility of organising applications with provincial governments, with the idea that these applications could then be shared with other principal governments, was suggested. This idea offers the advantages of economising on the overall work, speeding implementation, decentralisatising resources to some extent toward other centres, and building a wider cadre of involved participants. The process also offers a further *ad hoc* evaluation in the speed of take-up of these applications by other governments.

As discussion in several plenary sessions has made clear, the opportunity to achieve a coherent, uniform information structure in China should not be lost. China's society has to achieve a leap from an agricultural society to an information society in one generation. It also has to achieve a leap to a comprehensive information (not computer) system in less than a generation. But just as it may be possible to avoid the mistakes of the Western world in industrialisation, it may also be possible to draw on existing modern technology to leap over many of the mistakes made in early stages of informatisation in developed countries. To make this leap, all users and participants will have to see the SEIC as a useful and helpful ally, not as a source of rules and restrictions which inhibit innovation and new initiatives. In the market economy prompted by economic reform, with rapid technological change, only very general guidelines and procedures and standards oriented toward user needs, and user education, stand any chance of success. Ex post evaluation has to be directed toward measuring success in achieving these goals, which reflect the concrete and particular needs of China in the coming years.

WORKING GROUP E

DECISION SUPPORTING TOOLS FOR DECISION-SUPPORT SYSTEMS

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Peng Guangyan
Si Tu
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Tang Jianbang
Tong Shoubin
Robert Valantin
Wang Tong
Wang Yongling
Wang Zhenji
Wang Zhengwei
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Xie Cong
Xue Huacheng
Yang Jijian
Yang Wenhu
Yongjie Deng
Awad Elkarim Yousif
Yu Yuanning
Zhang Ruhao
Zhang Yuansheng
Zhao Qidi
Zhu Chenglie

WORKING GROUP E REPORT

1. A **background paper** by Tony Buttigieg of the Treasury Board of Canada provided the stage and basic conceptual framework for the work of the group, and is annexed to this report. The paper provided a generic model of an organisational information system and traced the evolution from Electronic Data Processing (EDP) to Management Information Systems (MIS) to Decision-Support Systems (DSS).

2. To the **basic components of a DSS** identified in the paper (see Figure 2) - the Data base, the Model Base, the User Interface and the User/Decision-maker - it was proposed to add several additional elements:

- a Processing/Support Module (e.g. Statistical processing software, or the inference engine for expert systems)

- an Evaluation module

- a Methodology Base (to contain non-quantitative models)

3. The **application of the above DSS schema to systems based on Expert Systems techniques** was debated extensively. One proposed revised version of Figure 4 in the background paper would include:

- Data base - Facts }
} "Knowledge Base"
- Model Base - Rules }

- Processing Module - Inference Engine

- User Interface

- User/Decision-maker

- Evaluation Module

4. **Decision Support Systems were seen to be constructed using various tools,** including spreadsheets, simulation models, expert system techniques, and user interface support software, such as interactive graphics, etc.

5. One example of a type of tool being used is the **Expert System Shell.** Until very recently, Expert Systems were mainly used to solve large problems. They cost a lot of money to develop and were almost always main-frame based. For example, PROSPECTOR, a program which uses data from geological surveys to locate valuable mineral deposits, cost approximately USD 2 million to develop. But now, Expert Systems can be developed quickly and cheaply on PCs using program shells that can cost as little as USD 100 and on up to USD 10,000.

An Expert System shell "knows" how to manipulate knowledge and make decisions based on a set of rules. The only programming that remains requires an expert to input the rules which apply to the types of problems under consideration. The person who uses the program answers a series of questions which emulate a consultation with an expert. For example, for a program that diagnoses the fault in a TV set, the user types in the answers to questions, such as "Is the TV screen blurred?" Following the question-and-answer session, the computer determines specifically what is wrong with the television set and what must be done to repair it. If the user wants more information, the program can explain how the decision was reached by listing the rules that applied. Depending on how the program was created, it may also provide, for example, a diagram showing the location of the focus control button and instructions on using it.

The task of programming with an Expert System shell is less difficult than using a database or a spreadsheet program as long as the rule logic is understood by the user. The most difficult part in creating an Expert System is in determining all of the rules and possible outcomes that must be considered. However, for relatively small problems, it is possible to create a prototype within a day or two. The first draft of the prototype can be tested with problems to compare its results to those of a human expert. If necessary, rules can then be added or modified so that the program and the expert agree.

Some sample Expert System shell software products are mentioned below for illustrative purposes only.

VP-Expert, a shell for creating Expert Systems on IBM PCs and compatibles costs USD 150. It allows the expert to download data from spreadsheets or databases.

MACSMARTS can incorporate spreadsheet data in tabular ASCII format and can read and write database information in SYLK format. The program also interfaces with MACPAINT and HYPERCARD, Apple's information management system.

INSTANT EXPERT is a stand-alone shell costing USD 100. INSTANT EXPERT PLUS, which costs USD 600, accepts files created by INSTANT EXPERT, and interfaces with graphics and text files, databases and spreadsheets.

According to Mike Urlocken, writing on Expert System software, "Programs with expert knowledge in a variety of fields are becoming increasingly popular as low-cost, artificial intelligence products enter the personal computer market".

6. **Executive Information Systems** (EIS) were seen to be a type of DSS which focus on facilitating selective access to filtered indicators of interest to the executive function ("what is" rather than "what if" or "modelling" operations). An example from Uruguay is described below in section 7.B.

7. A number of **socio-economic information system applications** which can be considered, in whole or in part, as Decision-Support Systems, were described and discussed. These included several examples from Canada, reviewed in the background paper, as well as several presented by participants. Several of the latter are summarized below.

7.A. Mr. Eduardo Gamboa, Philippines

ECOKNOWMICS

ECOKNOWMICS (ECOnomic KNOWledge Management, Integration, and Communication System) is a microcomputer-based software package to help economic planners and policy makers overcome one bottleneck in the planning and policy making process: the generation of economic scenarios to reflect alternative policy assumptions and options. It uses Expert System techniques to allow the automatic generation of scenarios using models and databases, and to provide "explanation" facilities for the benefit of planners and policy makers who might want to know the empirical and theoretical basis of the generated scenarios. ECOKNOWMICS will perform the role of an electronic "intelligent assistant" serving the planners and policy makers.

A prototype version of ECOKNOWMICS is being developed at the National Economic and Development Authority (NEDA) of the Philippines by an interdisciplinary software team consisting of economists, statisticians, system analysts, and computer programmers. Software development is expected to last for twelve months (about 5 person-years altogether), with the last three months scheduled for day-to-day validation by NEDA planners and policy researchers.

7.B. Mr. Victor Ganon-Garayalde, Uruguay

Project URUCIB - Informatics for the Presidency of the Republic

Uruguay is a country of 2.9 million persons (half of them live in the capital Montevideo). The current President commissioned in 1985 a project to create a real-time information system to support decision-making at the Presidency and Cabinet levels. The project adopted Professor Stafford Beer's well-known cybernetic approach to information, management and control in enterprises and government.

The project had four major aspects:

a) The data network - which involved ensuring data links with enterprises, departments and other sources using the telex network.

b) Information, quantified flowcharts, and "Viable System Models" - the domain of the organisation specialists.

c) "Cyber-filter" - a software package and database where the time series is monitored for any change-of-state.

d) The "Management Centre" - where the information can be viewed in more or less detail or printed out.

Professor Stafford Beer's model of organisations (the Viable System Model) and also macroeconomic information are used in aspect (b).

The emphasis has been put on having few but representative indicators in "real time", which for our present system means knowing today what happened "yesterday". Separate quantified flowchart models were built for each enterprise.

The information that comes through the network is filtered, using the Linear Dynamic Model of Harrison and Stevens (fully described in the literature).

The major purpose of the "Cyber-filter" is to detect changes in the time series almost as soon as they occur (and not much later, as it is in the case of most national statistics indicators).

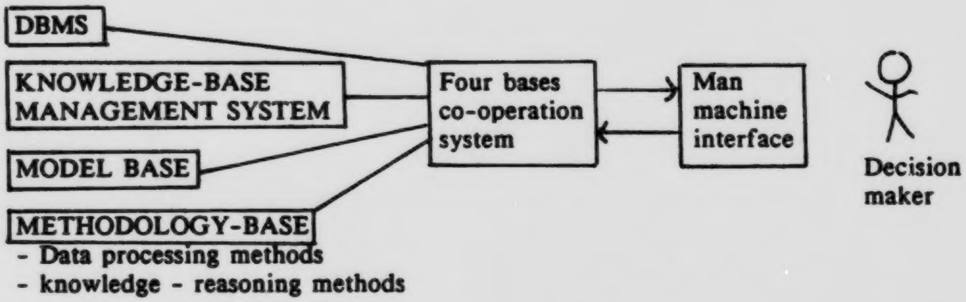
The information is then available to be displayed in a new environment designed for decision-making: the Management Centre, which is situated very close to the Office of the President.

The hardware for the project was bought on the market. It consists of 2 PC/ATs, a color printer, a display screen (100 cm x 140 cm) and a set of infrared numeric key pads for up to 5 users. The user-friendly software was written by the members of the project and design group of seven persons over the two years ending July 1988.

7.C. Professor Tu Xuyan, Professor Xie Hong and Mr. Yang Liang, China

Large System Cybernetics and Multilevel Intelligent Management System

Professor Tu presented a paper in which he defined Large System Cybernetics (LSC) as being a combination of Large Scale System Theory and Artificial Intelligence. LSC in turn provides a sound basis for the design of Large Scale Information Systems. Today AI techniques allow one to incorporate the initiative, originality, and flexibility of human beings in information systems, for maximal use of the human skills in collaboration with computer capabilities for data storage, analysis, and presentation.


DBMS
KNOWLEDGE-BASE MANAGEMENT SYSTEM
MODEL BASE
METHODOLOGY-BASE
- Data processing methods
- knowledge - reasoning methods
Four bases co-operation system
Man machine interface
Decision maker

The Four Bases Co-operation System (FBCS) enables information retrieval, expert consultation, model prediction, optimisation, and reasoning. A large-scale information system (Economic Information System at provincial level) is currently being built using the design methodology elaborated in this paper.

7.D. Professor Wang Tong, China

China's Macroeconomic Model System

A very large multi-level system of modules has been built since 1985 at the State Economic Information Centre (SEIC) using the TROLL mainframe software system (designed and built at MIT). TROLL provides storage for time-series, and enables systems of equations to be estimated and to be run as models. It also has powerful test statistics.

SEIC has its own "bank" of equations, which is linked to TROLL.

The TROLL system of estimated models includes a quarterly and an annual macroeconomic national model (both econometric). There is also a medium long-term dynamic input-output model compiled with some stochastic questions. This uses the latest (1982) I/O matrix which will be updated this year to 1987. The model has about 900 equations. It has been used several times.

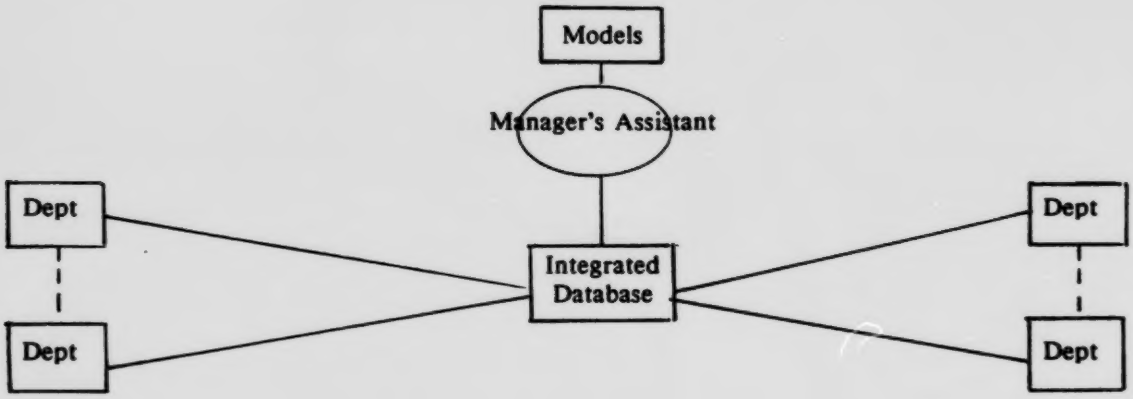
In addition, there are linkage modules involving financial, material and energy flows to relate the national models to 28 provincial and municipal models. In most cases, the data for these models is collected at regional level, but they are run (in the mainframe TROLL system) at Beijing. These second-level models have been standardised as to names of variables, the formats of the files etc. These models account for about 2000 equations. At present 11 of 23 sectoral models have also been built. There are also three zonal models (East, Central, West). This system of models will be the main one at the SEIC apex centre in Beijing.

7.E. Mr. Bojil Dobrev, Bulgaria

Mr. Dobrev told the group about **Expert Systems and DSS being worked upon in Bulgaria** and mentioned several areas of application, including DSS for investment allocations and Expert Systems in medical applications (a diagnostic Toxicology system), and the legal field. Expert systems were mainly PC-based. Many software tools had to be developed in Bulgaria due to restrictions on export of Bulgaria of certain software, such as Expert Systems Shells.

He spent some time explaining the design of the "Manager's Assistant", which is designed to access an enterprise's database and to do analyses. The Manager's Assistant is built to be portable between applications and is now widely in use in about 100 enterprises, local authorities, hospitals, colleges and universities, and Government Ministries.

The Manager's Assistant taps into the organisation's (integrated) database, and uses models where necessary. It uses data about the organisation's subunits and staff, legal provisions and economic data for the whole organisation as well as subunits, to perform Task Control, maintain Time Schedules, and also to perform other useful tasks, such as text-processing.



7.F. Mr. Awad Elkarim Yousif, Sudan

Mr. Yousif pointed out a number of **experiences in Sudan** which unfortunately had not led to successful information systems implementations. Common themes were the lack of appropriate or available data to feed the system and difficulties in ensuring cooperation between participating agencies/actors.

Mr. Yousif's presentation led to an interesting discussion on the need for active involvement of prospective users in various stages of system design and development. In some cases, a barrier was seen to exist between both sides and increased awareness of the other's needs.

8. One must also distinguish between **different levels of users** - top management, middle-level management, and the operational level. It was noted that once top management was behind a system, it has a much greater probability of successful implementation.

9. It should be noted that systems discussed were seen as **decision-support systems, rather than decision-making systems**, and that the role of the human decision-maker was integral to the

process. In addition to technical factors, there were often political issues to be addressed in making any final decision.

10. **Systems Integration/linkage issues** could be seen as involving three types of entities: system functions, data, and software tools. Interfaces are needed between DSSs from the user's point of view, between DSSs and MISs or database systems, and between DSSs and other knowledge-based systems. In addition, further integration of tools - statistical packages, database management systems, extended software tools such as graphics, applications generators, etc. - would facilitate system development, and some existing integrated commercial tools were already being used in systems development (see 7.A).

It was seen as important that linkages between systems or system components take place at an appropriate level of aggregation and involving commensurate degrees of automation.

11. In addition to the success factors identified in the background paper, and on which there was agreement, it was pointed out that the **correctness and appropriateness of the data** - a responsibility of the data owner - was crucial.

12. With regard to the **selection criteria for models**, some members felt that in a typical DSS, the degree of accuracy or precision of a model was less important to its utility than that it generally fit the same "world view" (scope and dimensions) of the model's users.

13. Regarding the **context of DSSs**, Wilbur Steger pointed out several aspects. In carrying out a decision-making process where simulation models, spreadsheets, expert systems and similar decision-making tools are used, those involving users -- planners, policy makers, public managers -- have increasingly stressed the need that the developers of these systems tools (e.g. systems analysts, public administration specialists, and computer scientists) help them move from the process and mechanics of these tools (e.g. model building) to the development of products that :

a) suit users' needs in providing them with products they want; and

b) further automate other components of the total decision-making structure which will facilitate the entire process, make it more cost effective, and enable their human advantages to be used to the fullest.

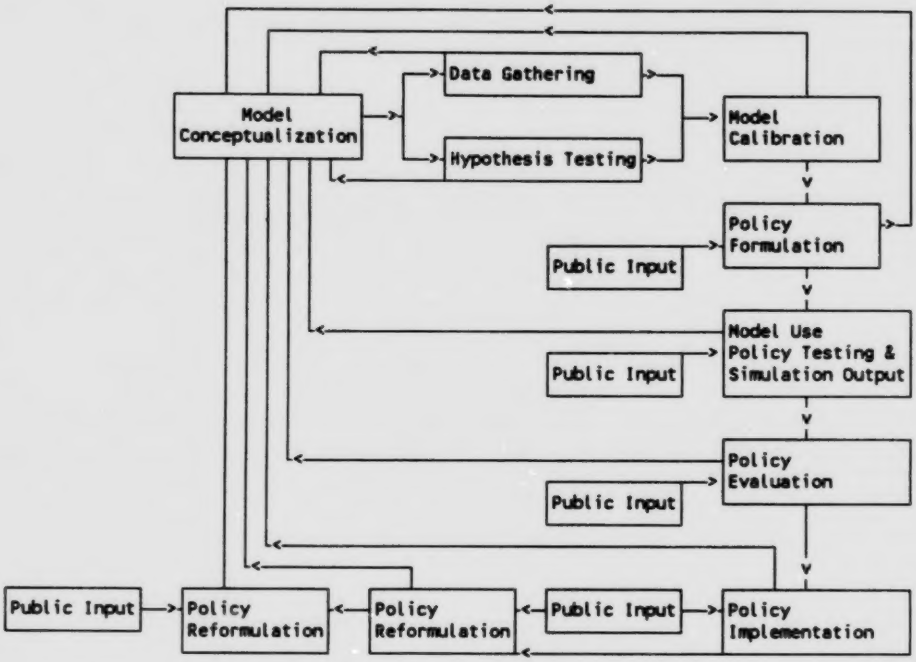
If one examines how such decision-making tools are utilised within a total structure such as a planning structure (see Exhibit 1), one can see many entry points for additional automatable decision-support tools and applications above and beyond those currently utilised. Whereas only "model calibration", "model use" and "policy evaluation" to an extent are automation-assisted currently, further decision-support automation can (and is beginning to) take place in a variety of other facets of the total structure, e.g.

. model conceptualisation
. hypothesis testing
. policy formulation
. policy evaluation (balancing of values), and
. policy reformulation.

In what is, perhaps, the most widely used and implemented such planning structure in the U.S. Government sector -- transportation/land-use modelling and information systems which are specified by legislation to select and design the configuration of the Federally-financed portion of the U.S. highway network -- users of this structure (planning managers, public and private officials and public participants) are increasingly finding ways to encourage the automation of more and more of the total planning structure of Exhibit 1 so as to make for a more effective and

Exhibit 1

Modeling Within a Planning Structure


Model Conceptualization
Data Gathering
Hypothesis Testing
Model Calibration
Policy Formulation
Public Input
Model Use Policy Testing & Simulation Output
Public Input
Policy Evaluation
Public Input
Public Input
Policy Reformulation
Policy Reformulation
Public Input
Policy Implementation

From : Michael Goldberg, "Simulating Cities : Process, Product and Prognosis", Journal of the American Institute of Planners, April 1977, p. 150.

efficient comprehensive decision-support system for urban and regional infrastructure and land-use planning.

14. More and more stress is being placed upon both the temporal and **spatial contexts** for decision-making - whether for planning, policy-making, and/or operational management purposes. The tremendous growth of the ICG/GIS ("Interactive Computer Graphics/Geographic Information Systems") fields, and the concommitant hardware and software industry development, offer strong evidence that where and when resources are used and the activities take place -- be they at a neighbourhood, urban, regional, or even national level -- is one of the most important foci of the decision-support system movement. International organisations (such as the Urban and Regional Information Systems Association and others) have led the way in the design and use of such spatially-oriented decision-support systems -- first through large-scale computer systems and now through many computer-based ICGs and microcomputer-based GISs.

15. In the area of **evaluation of DSSs**, clearly benefit/cost analysis in its widest and most qualitative and judgemental sense must be encouraged. This should be done before proceeding with systems implementation, and then, as the system is later designed and implemented, the review process should include at least the following :

. Benefits from significant improvement in decision-making productivity

. Benefits from improved analytical capabilities

. Problems with in-house development costs and technical resources

. Decentralisation/centralisation consequences

. Service delivery impacts (cost, speed of service)

. Worker environment and agency culture impacts (job satisfaction, supervisory changes, insecurity, organisational disturbance and conflict)

. Privacy/confidentiality impacts

. Political and administrative consequences (government structure, professional values, distribution of community power, distribution of budgets)

. Technology-based policy impacts (computer sophistication, computer resource sharing, data coordination)

. Extra-community/intelligence system consequences (e.g. military/defense, national economy)

16. Mr. H. E. Haslyn Parris, Deputy Prime Minister of Guyana, contributed some ideas on the **key problems facing decision-makers in the newly emerging countries**, which appear to be different from those seemingly of interest to MIS and DSS professionals from developed countries.

The first key issue is the linkage between policies (announced, proposed, or undertaken) and social indicators. Is there any success in making the necessary changes in terms of:

- health and health practices?
- nutrition and food habits?
- education (levels and felt needs)?
- productivity?

These do not seem to appear in any MIS design.

The LDC politician is also vitally concerned with the Quality of Life. Usually he bumps into it through questions when he makes a speech. Do the people have : Enough to eat? Water? Transport? Goods transport when it is needed? Employment? Medical Services? Drainage/irrigation? Reasonable prices?...

This kind of information must be available on a spatially-disaggregated basis, and in a timely manner so that some corrective action can be taken. Perhaps the "Cyber-filter" technique could be useful here.

Most LDCs are in macroeconomic trouble. They have foreign debt difficulties: they must talk with IMF/IBRD/Paris Club. But without a debt-management DSS and/or some macro-economic MIS models, they have a very poor position in the discussions. This is an urgent need.

In regard to economic growth, tools would be useful such as update inventories of natural resources and human resources, with information also on relevant nationals now abroad. Tools to assist the search for appropriate technologies for exploitation of local natural resources are needed. Also (since most LDCs have open economies with large import/export sectors) tools and information sources are required to provide information about market opportunities and about alternative sources of needed inputs.

Most LDCs involve decision-making in a milieu of shortages : DSSs are needed to help in allocation (and location) of both human resources and money.

CONCLUSIONS

17. As a **Summary Perspective of Decision-Making and Decision-Support Systems and related tools**, the following points were presented:

A. Ideal Decision-Making System = Decision-Maker + Decision-Support System
(Human) (Machine)

- Thus, there is a need for an interface between human and machine.

- The interface should be human-oriented (not machine-oriented) and built into the machine.

B. The following are functions of a Decision-Making System:

1. Recognition of Problems
2. Formulation of Models
3. Validation of Models
4. Evaluation of Models (Model Solutions)
5. Management and Execution of Models
6. Management and Retrieval of Data
7. Influence of Decisions (Solutions to Problems)

C. Decision-Support Systems are evolving toward:

1. Providing more human-oriented interfaces;

2. Providing generalised "problem-processors" to handle the above-mentioned functions; and

3. Providing Databases, Model Bases and Problem-domain-specific Knowledge Bases for the use of the problem processors.

D. Examples of DSS and component tools and their principal functions (functions taken from B above):

(EDP/MIS/Database Systems)*	(6)
Spreadsheets/Simulations Packages	(5)
Statistical Packages	(3), (5), (6)
Expert Systems	(1),(2),(3),(4),(5),(6)
Executive Information Systems	(1),(6) and (7)

*Note : Provided for historical comparison only.

RECOMMENDATIONS

18. Working Group E recommended the following:

A. Decision-Support Systems and Expert Systems techniques have just begun to be used. Therefore, study of the Methodology of Design and Implementation of Decision-Support Systems and Expert Systems should be encouraged.

B. The Working Group noted that some developing countries are making serious efforts to develop Decision-Support Systems. To assist with this process, an assessment and evaluation of this developing-world experience would be of value to other countries which are likely to enter this field over the next 5 years. Therefore, it is recommended that funding be sought so that during the next two years a research effort is made :

i) to study these (and other) DSSs, especially as applied to Economic Information Systems, in developing countries, in context, and on a systematic basis;

ii) to compile this experience of system construction and use;

iii) to assess and evaluate the results for the benefit of other potential users; and

iv) to widely disseminate the resulting report in an appropriate form.

WORKING GROUP E - BACKGROUND PAPER

DECISION SUPPORT SYSTEMS

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1. INTRODUCTION

Many of the viewpoints, definitions and concepts discussed here are based on the North American experience, and are intended as a basis of discussion only.

This paper is organized as follows:

A. 1. A generic model of an Organisational Information System including attributes that characterize and distinguish its major components

2. A definition of a Decision Support System and its major structural components

3. The significance of Decision Support Systems

B. Some of today's major types of Decision Support systems, together with the organisational context in which they are used.

C. Socio-economic applications of Decision Support Systems, using examples from both inside and outside the Government of Canada.

D. Finally factors that contribute to a successful Decision Support System.

2. A GENERIC MODEL OF AN ORGANISATIONAL INFORMATION SYSTEM

An organisation's use of computerised information systems traditionally evolves from Electronic Data Processing Systems to Management Information Systems and then, occasionally, to Decision Support Systems. The majority of today's organisations depend on Electronic Data Processing Systems and Management Information systems. However, there is a growing realisation that an overall Organizational Information System must be a confederation of all three of these types.

We will describe each information system in terms of the decision-maker using the system, the types of decisions supported by each system and the design and operation of each (S. Neumann et al., 1980).

2.1. Components of an Organisation Information Systems

2.1.1. Electronic Data Processing System

Electronic Data Processing Systems (EDP) or transaction processing systems (TPS), are pure data processing programs that record and collect data; convert, verify and validate data; complete file updating and processing; and generate reports based on the data. TPSs support activities at the operational level of an organisation, by handling most of the workload of the overall organisational information system.

The decisions supported by a TPS tend to he highly structured. They are based on clear logic ; their time horizon is short; and they are usually routine, repetitive and programmable. The desing of TPSs follow the traditional systems development process with a well defined data base or file environment operating as either an online or a batch system.

A basic payroll system is an example of a TPS. Here, the emphasis is on clerical use, the orientation is towards mechanical efficiency, consistency, and reporting on information from the past.

2.1.2. Management Information Systems

A Management Information System (MIS) is a system with pre-defined data gathering and reporting capabilities, often built upon a TPS. A MIS supports decision-making only at the problem definition and data collection stage of the process. However it can do so at all managerial levels. A MIS is most often used at the operational level, and least often used at the executive level. The decision-maker's involvement in system development and use is passive. The decision-making style is predetermined, universal and impersonal.

The decisions supported by a MIS are structured with historical or past-oriented, time-horizon perspective. System use is routine with a well defined, algorithmic decision-making process, supporting local or operational decisions. The data sources are largely internal with a well described, narrow and specific data base and a model base of quantitative, universal pre-determined models. The data oriented system design operates in an online or batch mode and the frequency of use is predetermined. System success criteria include stability, dependibility and operational efficiency. An example of a MIS is a payroll system with managerial reports on labour distribution.

2.1.3. Decision Support Systems

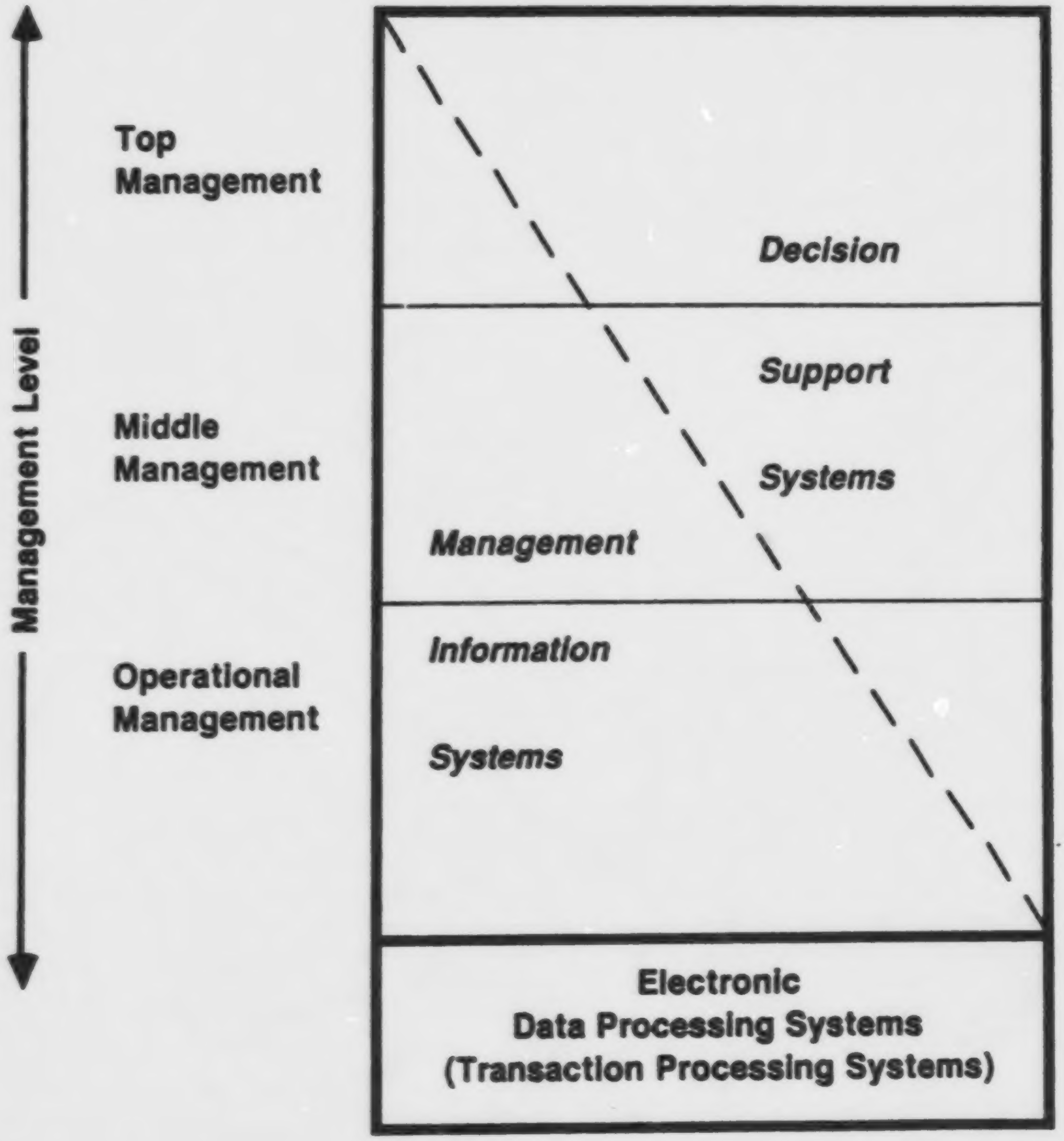
A Decision Support System (DSS) can be characterised as an information system with decision modelling capabilities and an intrinsic capacity to support ad hoc data anlaysis and reduction. A DSS relies upon the existence of both transaction processing and MIS data bases. DSSs can support all phases of the decision-making process, and all levels of the organisation - operational, middle and executive management. They are mainly used at the executive level or by professionals (economists, engineers, planners, doctors) and less frequently at the operational level. The decision maker's involvement in system development and use is active, individualistic and personal and the environment is complex and changeable.

The decisions supported by a DSS are usually unstructured, characterised by a trial-and-error approach, intuition and common sense. Factors and outcomes relevant to the logic tend to be vague and more qualitative than quantitative, and the decisions carry a long future-oriented time-horizon, by nature non-programmable. The decision-making process is heuristic, iterative and exploratory. System use is often ad hoc and unique, contributing to decisions that are of strategic importance. The sources of information are large external data bases. The decision/model oriented system design operates in an interactive mode with an undefined frequency of use. System success criteria include flexibility and adaptability. An example of a DSS is a payroll system with both preformatted managerial reports and the ability for users to carry out "what if" analysis based on the payroll information database.

Figure 1 illustrates a generic Organisational Information System composed of EDPs (TPS), MISs and DSSs. Each of these systems supports decision-makers at various levels in the organisation and at various stages of the decision-making process. Each information system is interrelated, with EDPs (TPS) providing the basis for MISs and DSSs; yet each is also independent enough that it does not impede separate development.

Figure 1

A Generic Organizational Information System Model


Management Level
Top Management
Middle Management
Operational Management
Decision
Support
Systems
Management
Information
Systems
Electronic
Data Processing Systems
(Transaction Processing Systems)

2.2. Decision Support Systems - Components

A Decision Support System consists of three major integrated components - a data base, a model base and a user interface.

The database and model base are managed by software support systems that work closely together to facilitate the necessary flow of data. Both can be directed by a command language through a terminal that allows the decision-maker access to both the data and the models and manipulates them to support decision-making (R.H. Sprague, 1979).

The DSS contains a database and a database management system for generating, maintaining, accessing and controlling the data. The database contains internal data, such as files on historical and management data, and transactional data related to personnel and finance, and it also contains external data: political, social, economic and the like.

The database management system possesses data management functions. It allows people to communicate with the database to create, restructure and update files, select, retrieve and sort data and generate reports. Reporting requirements range in complexity from simple ad hoc reports to more complex status and exception reports.

Graphics capabilities, in the form of time option plots, bar or pie charges and scatter plots add greatly to their effectiveness.

The model base consists of a series of models that can be used to manipulate and analyse data to solve executive problems, such as defining objectives, determining policy or assessing the envrionmental impact, planning or non-routine capital budgeting. Middle management challenges, such as financial and manpower requirements planning and routine capital budgeting can also be handled. Operational problems, including inventory control, quality control and production scheduling are also amenable to model base manipulation.

Model building blocks and sub-routines, such as linear programming, capital budgeting and statistical models (time series analysis, multiple regression and analysis of variance are also contained in the model base. These model building blocks and sub-routines are used to construct other models.

Another essential component of the DSS model base is the model base management system, used to manage the models and the model building blocks. Analoguous to the functions of the data base management system described above, model base management software can perform the following functions (N. Ahituv et al, 1983):

a) periodic runs of well established models

b) special results of an ad hoc model

c) data analysis models

d) interactive reruns of a model or set of models

e) sequential runs of a set of interrelated models accroding to predefined procedures.

Allowing flexibility of both input and output, the model base management system is both user-friendly and adaptable.

The DSS user interface consists of a terminal and command language the user employs to access, retrieve and update the database and the model base and to generating reports. In general, the user interface controls interactive processing.

The terminal devices generally consist of a terminal hooked up to a mainframe directly or by telephone. Microcomputers with a modem are being used more frequently for this interface (B.C. Reimann, 1985). User-friendly CRTs or a menu-driver system allow a manager to obtain instant feedback through direct access to a computer. When enhanced with graphics, column capabilities and plotters, these fast and reliable terminal devices are a potent element in aiding the decision-makers' interaction with the Decision Support System (R.H. Spargue 1979).

The command language, used to gain access to manipulate the data and models in the DSS, must be flexible enough to accommodate a wide variety of decision-making styles, yet powerful enough to be human-oriented (R.H. Sprague, 1979). The command structure must be in the form of a simple language in order to be available to a full spectrum of decision-makers, from executives to systems analysts or to operational users. The command language must also be hierarchical with macro commands to determine which models to run and which data to access or procedures to implement (R.H. Sprague, 1979).

Figure 2 illustrates the basic structure of a Decision Support System, including the model base, the database and the user interface.

2.3. **Significance of Decision Support Systems**

Many of the significant benefits of DSSs, although difficult to measure or describe in specific terms, are effectively summarized as follows (S. Yoo and L.A. Digman, 1987):

a) facilitate more efficient and effective management at all organizational levels;

b) ensure the increased timeliness and accuracy of organisational information through rapid updating;

c) allow for improved horizonal and vertical communication within the organisation;

d) permit a long-term management viewpoint;

e) catalyse changes within the organisation, especially strategic management ;

f) facilitate more rapid and efficacious decisions.

3. TYPES OF DECISION SUPPORT SYSTEMS

Several of the more popular types of Decision Support systems include :

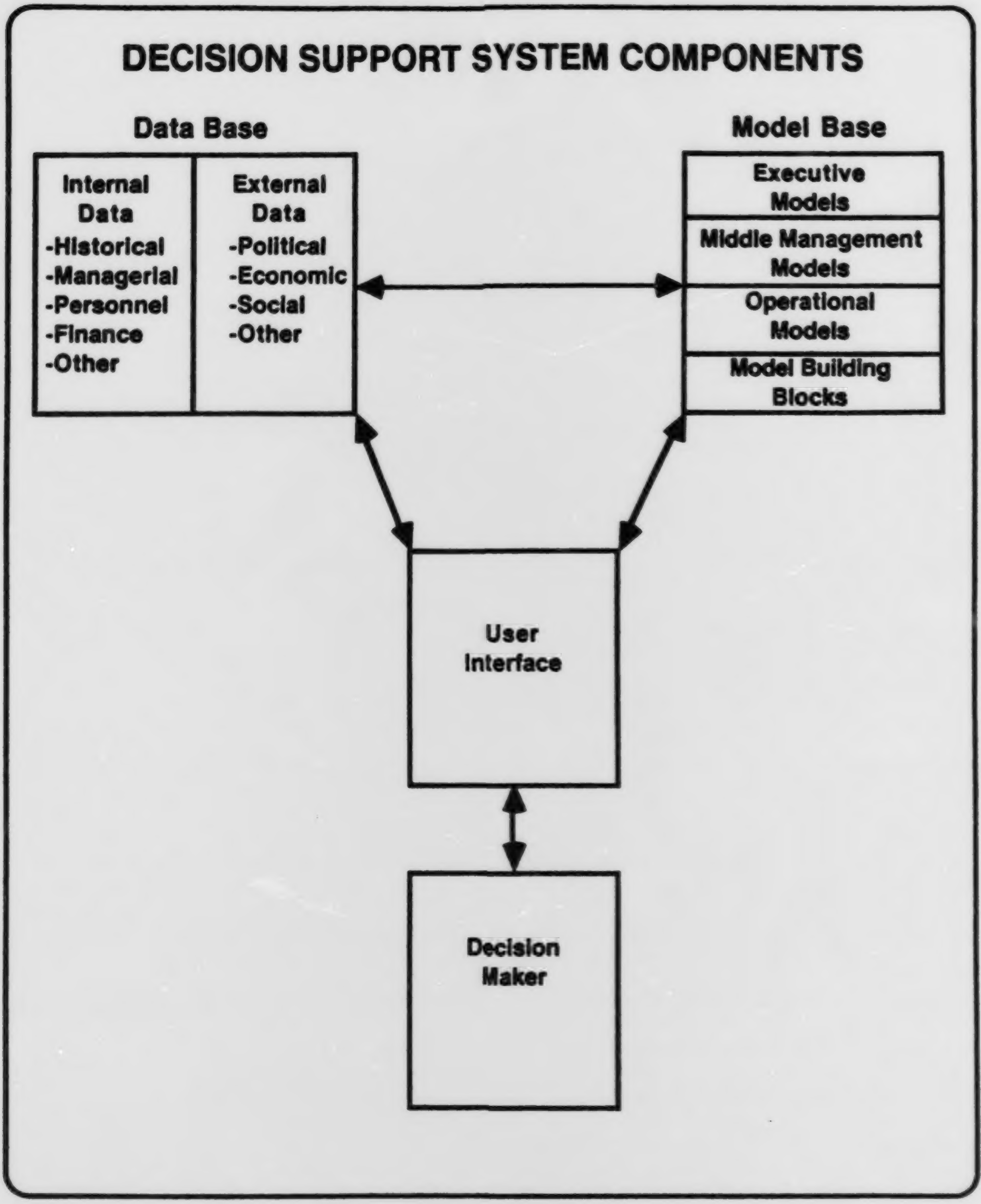
1. Spreadsheets
2. Simulation Models
3. Expert Systems
4. Executive Information Systems

We will describe each in terms of a definition and/or component parts and the organisational context into which it fits.

3.1. **Spreadsheets**

Spreadsheets are the simplest and most common form of DSS. With the advent and popularity of personal microcomputers in the last ten years, spreadsheet applications have become widespread and many spreadsheet applications can be characterised as DSSs.

Figure 2


DECISION SUPPORT SYSTEM COMPONENTS
Data Base
Internal Data
-Historical
-Managerial
-Personnel
-Finance
-Other
External Data
-Political
-Economic
-Social
-Other
Model Base
Executive Models
Middle Management Models
Operational Models
Model Building Blocks
User Interface
Decision Maker

A spreadsheet is essentially a sheet of paper divided into columns and rows. At the intersection of each column and row there is a cell. Each cell contains two items: the contents (either a value, a label, a special indicator or nothing at all) and a formula for determining the contents of that cell. Spreadsheets allow the user to work with a large set of interrelated values and formulae; to make corrections, additions and deletions quickly and easily; and to perform numerous "what-if" analyses by changing some cell values and watching the results. Mathematical, logical, financial, statistical and data functions built into the spreadsheets make calculations easy to perform.

Running on mainframes, minis and micros, spreadsheets are used by decision-makers at all levels to solve more problems for more people throughout the organisation than any other DSS.

Spreadsheets have limited report writing features, they lack an automated audit trail of changes made, their models are simple, and there are difficulties in accessing large databases. But despite these limitations, spreadsheets are used for a variety of purposes, including financial planning, business record keeping and accounting, budgeting, statistics, general ledger accounting and many more.

3.2. Simulation Model

Simulation models were the first type of DSS that emerged. A simulation model is a simplified representation of real life allowing a person to explore a problem using trial and error. Simulation models can be used to describe the behaviour of a system, construct theories that account for observed behaviour and, using these theories, predict future behaviour.

Simulation models can be classified in a number of ways. Two of the most common include (R. Shannon, 1975):

a) Static or Dynamic. A static model represents the entity being modelled at a specific point in time. A dynamic model represents the behaviour of an entity (organisation) over a period of time.

b) Deterministic or Stochastic. A deterministic model is one in which the definitions of certain variables or parameters produce an output that is determined solely by a given input. A stochastic model, on the other hand, is one in which there is an uncertain output for a given input.

The steps involved in building a simulation model include the following (S.S. Mitra, 1986):

a) Model formulation: the determination of model components; gathering time utilization, resource use and historical data; linking all the parts and testing them for overall system validity; and, finally, determing time incrementation.

b) Design the experimental procedures: outlining which characteristics of the simulated system should be measured and what scope and detail are involved.

c) Developing a computer program: using FORTRAN, APL, Pascal, C, or a simulation language. This usually is done by people with a significant level of programming skills.

Computerised simulation applications are used in a variety of contexts:

- to compare a finite number of strategies performed on the elements of an individual problem

- to develop functional relationships; and

- to validate or evaluate newly developed analytical methods.

Computerised simulation applications offer the advantages of realism, speed, risk avoidance, and the flexibility to explore and revise the knowledge represented in the simulation. They are widely used by middle and executive managers to support decision-making in terms of planning and evaluation.

Figure 3 illustrates the basic structure of a typical simulation model.

3.3. Expert Systems

Expert Systems (ES) have only recently evolved as DSS tools and there are few examples of their use in public administration. They are programs that use specialised knowledge about a particular problem area, and symbolic and often qualitative reasoning to solve difficult problems (F.L Luconi et al 1986). The components of a typical ES, described by B.A. Bowen in "Introduction to Design of Expert Systems", are as follows:

a) The Knowledge Base or data base consists of a set of facts, formal relations and heuristics of the problem area representing all the knowledge obtained from an expert. It contains three types of knowledge - deep, shallow and compiled - about the problem area. Each type must be integrated into a practical system. Facts are collected, and heuristics are organised using production rules (i.e. 'If' 'Then' rules, used to represent empirical consequences of a given condition or criterion between cause and effect). These lists of production rules can then be organised into semantic networks (another formalism used to represent certain kinds of relational knowledge). Knowledge representation techniques, such as production rules and semantic networks, permit the capture of knowledge in a way that can be used by the Inference Engine to produce answers to questions.

b) The Inference Engine is a mechanism for exploring the knowledge base to arrive at an answer to a problem. A variety of techniques can be used to examine the knowledge base. Two of the most popular include forward chaining (whereby the chain of reasoning starts from a set of input conditions and moves forward toward a conclusion) and backward chaining (whereby the chain of reasoning starts with a conclusion and moves backward to discover the input conditions).

c) A User Interface allows the system to communicate with a user.

Expert Systems are an extension or a logical progression of the DSSs in the evolution of computer systems development. ESs support all phases of the decision-making process, particularly during problem identification, data collection and planning for alternate solutions. An ES can also improve decision-making at all levels of an organisation, especially at the executive level, by preserving and disseminating scarce expertise and making it available as a resource to less experienced managers (F.L Luconi et al, 1986).

Figure 4 illustrates the basic structure of a typical Expert System.

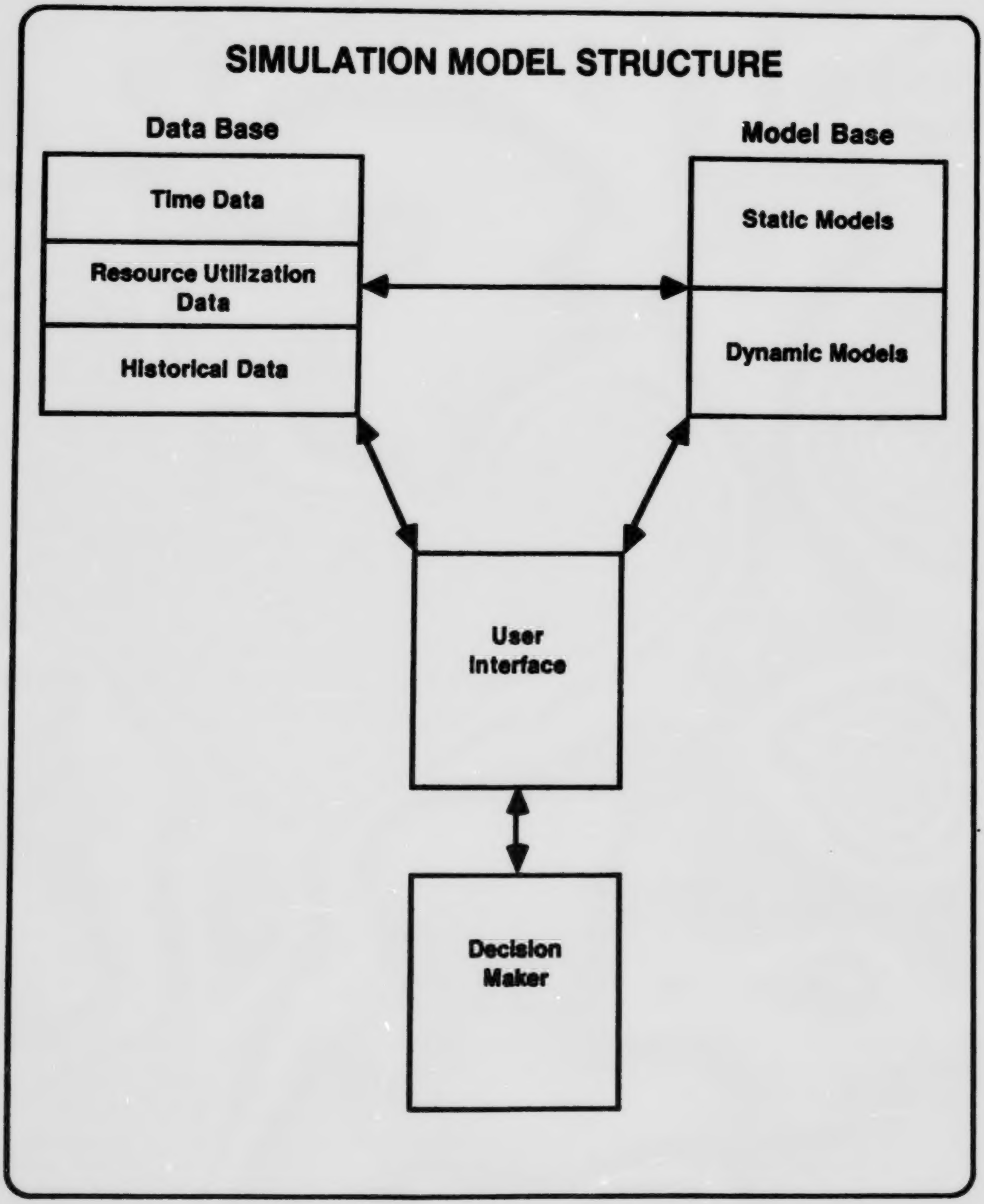
3.4. Executive Information Systems

A further and more recent refinement of the DSS concept comes in the form of an Executive Information System (EIS). As with ESs, there are few examples of their use in public administration. An EIS is a computer-based information system specifically designed to meet the needs and decision making style of top executives. An EIS includes a tailored database containing detailed past, present and future data by business unit. It provides easy access to the current status and projects trends on the business (E. Turban et al, DSS-87). The User Interface allows the user to interact with the system.

In a general sense, an EIS can be considered part of the decision support field. Several differences do exist, however, which can be used to characterise the organisational context in which it is used (E. Turban et al, DSS-87) including:

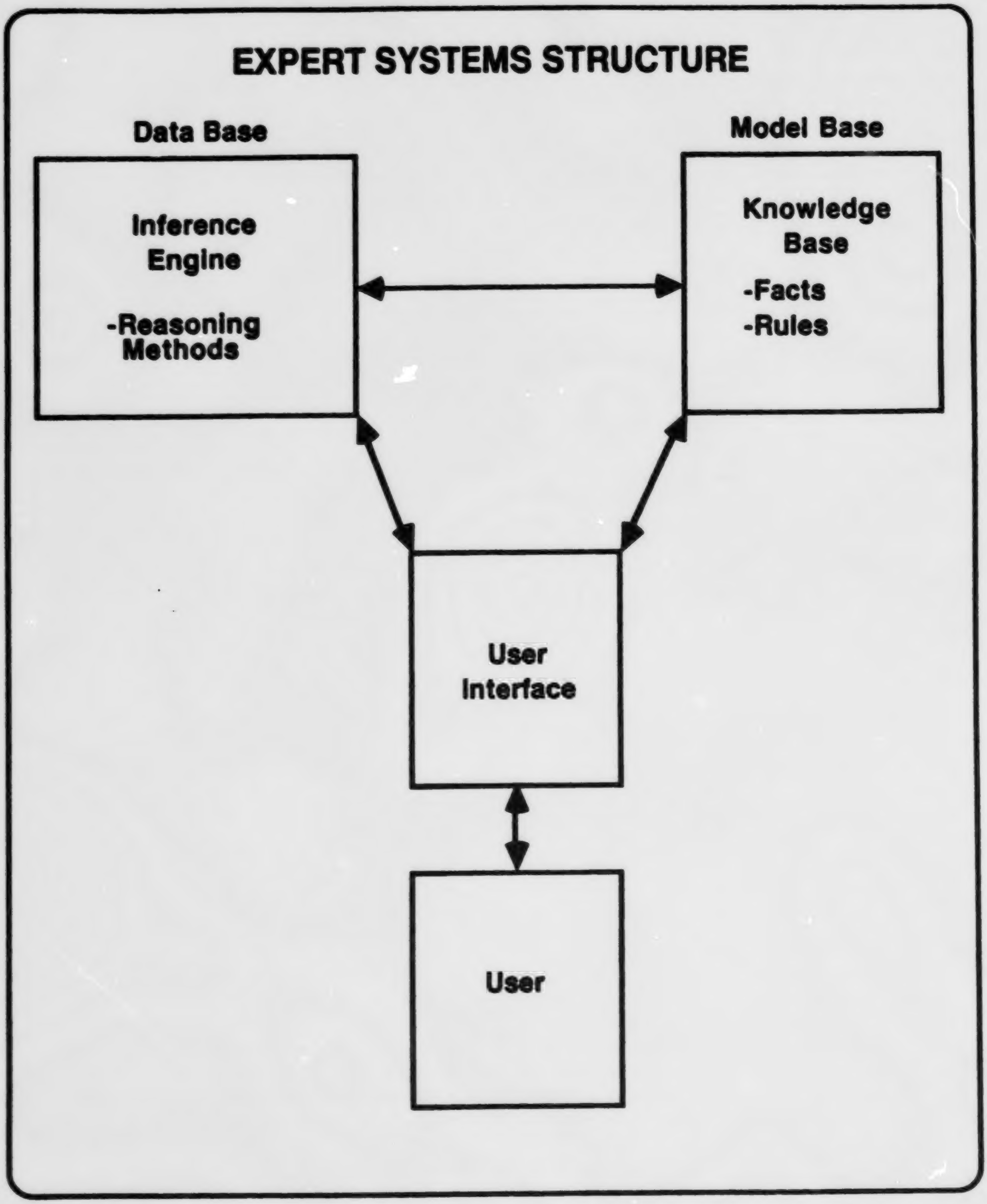
1. The focus of an EIS is the current status of a situation, answering "what is" questions, as opposed to other types of DSSs, which ask "what if" questions.

Figure 3


SIMULATION MODEL STRUCTURE
Data Base
Time Data
Resource Utilization Data
Historical Data
Model Base
Static Models
Dynamic Models
User Interface
Decision Maker

OCG 4000-3

Figure 4


EXPERT SYSTEMS STRUCTURE
Data Base
Model Base
Inference Engine
-Reasoning Methods
Knowledge Base
-Facts
-Rules
User Interface
User

2. Users of EISs tend to be at the executive level of the organisation. Here, the EIS is used at the problem identification and data collection phases of the decision-making process to give managers information about which they can ask questions. Other types of DSSs support all managerial levels of the organisation and all phases of the decision-making process.

3. In contrast to the extensive modelling and analysis capabilities of other DSSs with their primarily internal database(s), EISs have no model bases, but contain diversified external data base(s). This is true, especially when executive decisions are concerned wtih organisational competitiveness, the system's response to external factors and the ability to relate decisions to the internal environment is important.

4. EISs generate structured schedules, demand reports, news items, exception reports, and the like, to enable managers to monitor and scan their environment. Other DSSs supply information to support specific ad hoc and semi-structured decisions and to provide routine analysis.

Figure 5 illustrates the basic structure of a typical Executive Information system.

Spreadsheets, simulation models, ESs, EISs and other DSSs provide a relatively new and powerful tool in Information Systems technology. They can improve the effectiveness of managers in organisations by supporting decision-making and decision-makers at all levels.

4. SOCIO-ECONOMIC APPLICATIONS OF DECISION SUPPORT SYSTEMS

In Canada, a wide variety of Decision Support System applications are used, particularly spreadsheets and optimisation and simulation models. Other applications in the form of Expert Systems and Executive Information Systems are still in their infancy and few are in production.

In this section, Canadian examples of economic applications for governmental and non-governmental organisations will be presented. Each DSS model will be briefly described in terms of the setting in which the system is used, its major functions and technical configuration, its users and its impact. Economic applications have been selected from the following organisations

1. Bank of Canada

2. Department of Finance

3. Economic Council of Canada

4. Conference Board of Canada (a non-governmental policy and economic research organisation)

5. Statistics Canada

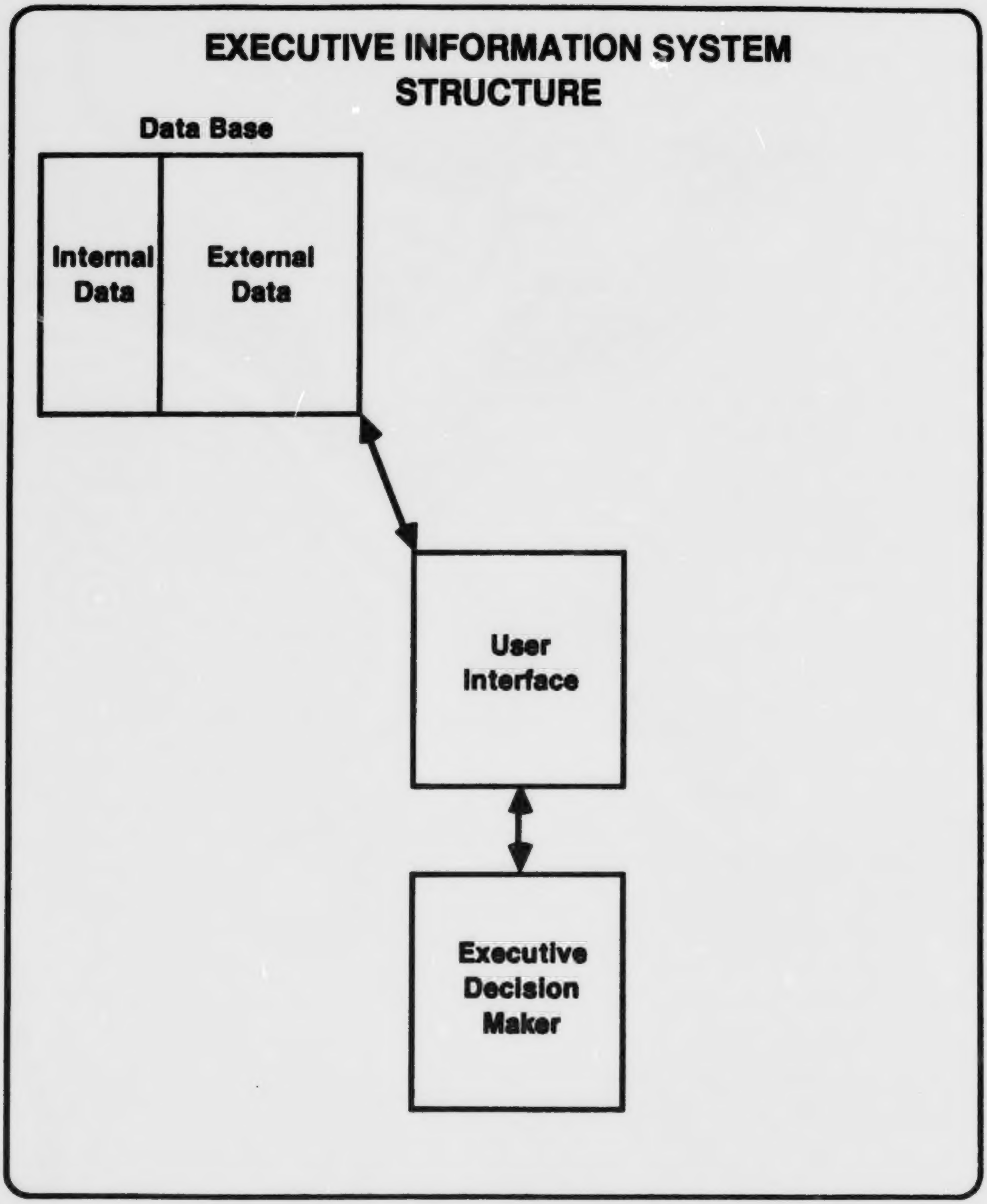
6. Transport Canada

7. Energy, Mines and Resources

4.1. Bank of Canada

The Bank of Canada's function is to regulate credit and currency in the interests of the economic life of the nation. It also controls and protects the external value of the national monetary unit and mitigates, by its influence, fluctuations in the general level of production, trade, prices and employment as far as is possible within the scope of monetary actions.

Figure 5



EXECUTIVE INFORMATION SYSTEM STRUCTURE

Data Base
Internal Data
External Data
User Interface
Executive Decision Maker

The Time Series Processor (TSP) is a DSS application used by the Policy Department of the Bank of Canada for economic analysis, model estimation, simulation and forecasting. Specifically, the TSP performs statistical and time series manipulations using the following operations :

- non-linear least squares (single and multiple equations)

- discrete simulation analysis

- computation of indices

- computation of descriptive statistics

- graphics.

TSP was implemented in two basic versions - TSP/UNIVAC and TSP/PC. TSP/UNIVAC runs in a service bureau environment on a UNIVAC 1100/81. A mainframe computer under the Exeuctive 39R5 operating system and a PC interface. TSP/PC runs on an IBM XT or AT microcomputer under the PC-DOS operating system. Both versions have the same functionality and command syntax.

TSP is used by Bank of Canada economists and their research assistants as a tool to assist in the formulation of monetary policy.

Based on earlier versions of TSP authored at Harvard, MIT and the University of Wisconsin, a more sophisticated version was internally designed, developed and put into production in 1975. Ongoing enhancements have only served to make the TSP more user friendly, to increase functionality and to extend the accessibility of this excellent resource to approximately one hundred users.

4.2. Department of Finance

The Tax Policy and Legislation Branch of the Department of Finance is responsible for setting policy on:

a) personal income taxes
b) federal sales and excise taxes
c) corporate income and resource taxes.

The General Equilibrium Model (GEM) is a DSS application used by this Branch to simulate the effects of potential tax reforms on the Canadian economy. GEM is composed of two numerical, multi-sector competitive models:

a) a small, dimensional (8 sectors), dynamically sequenced equilibrium model used primarily to analyse corporate tax changes; and

b) a forty-four industry, forty-two household static model used primarily to analyse sales and personal tax changes.

GEM was implemented in 1985 on an IBM mainframe-based system under the CMS operating system with a PC interface.

Designed, developed and implemented internally at the Department of Finance, GEM is being used internally by a limited number of branch economists to simulate and analyse tax policy changes.

4.3. Economic Council of Canada

The Economic Council of Canada is a national research and advisory body established by Parliament in 1963. The Council has broad terms of reference to advise and to recommend how Canada can achieve the highest possible levels of employment and efficient production in the medium and longterm. This service is provided to help ensure that the country enjoys a high and consistent rate of economic growth and that all Canadians share in rising living standards.

The Applied Regression and Econometric Modelling System (AREMOS) is a simulation/forecasting DSS application used bythe Council to perform the following functions:

a) manage and analyse economic and financial data

b) specify and estimate equations

c) build econometric models

d) run simulations or alternative scenarios

e) retrieve data and generate reports

f) create tables with spreadsheet functionality

g) produce graphics for analysis and presentations.

AREMOS was implemented in three basic versions: AREMOS/PC, AREMOS/VM and AREMOS/LAN. AREMOS/PC runs on an IBM XT or AT microcomputer under the PC-DOS operating system. AREMOS:VM runs on mainframe computers under the VM/CMS opreating system or under the VM/PC operating system on the XT/370 and AT/370 microcomputers. AREMOS/LAN operates on Local Area Networks that are "Net Bios Compatible". The different versions of AREMOS have the same command syntax, working of prompts and responses, and functionality.

AREMOS is used by economists, analysts and planners at the Council as a tool to conduct research and recommend policies.

Developed by Whatron Econometrics (a U.S.-based firm providing economic forecasting services) AREMOS was installed at the Council two-and a half years ago. This sophisticated, integrated tool has helped the Council by increasing productivity because it is easy to use.

4.4. Conference Board of Canada

The Conference Board of Canada is this country's pre-eminent independent, non-profit research institution. It has over 800 associates across Canada and 3200 associates world-wide. The Board conducts applied research in economics, compensation and human resources, management policies, public issues and international business. It produces a range of scientific studies in these fields and provides a personalised information service to all its associates.

The Medium-Term Forecasting Model (MTFM) is an econometric forecasting DSS application used to produce forecasts of over 2000 macroeconomic indicactors. It provides associates of the Board with economic information that will help them in their decision-making processes. MTFM is a multi-sectored model designed for forecasting and simulation over the short to medium term.

MTFM was implemented in two basic versions: MTFM/mainframe and MTFM/PC. The mainframe version of MTFM runs on an IBM mainframe under the CMS operating system. The MTFM/PC runs on an IBM XT or AT microcomputer under the MS-DOS operating sytsem. Both versions have the same functionality and command syntax.

The Medium Term Forecasting Model is used by many Canadian corporations, government departments and agencies, labour unions, industry and trade associations, universities, public libraries and individuals. MTFM was designed, developed, implemented and put into production internally by the Board in 1982.

With a predictive accuracy rate ranging from 90% to 99%, this resource has provided its users with consistently reliable economic information on which to base their decisions.

4.5. **Statistics Canada**

As part of their mandate, the Social and Economic Studies division of the Analytical Studies Branch of Statistics Canada provides data and tools to facilitate the analysis of social policy in Canada.

The Social Policy Simulation Data Base/model (SPSD/M) is a DSS application used both inside and outside the division to assist those interested in assessing the cost implications or income redistributive effects of changes in the tax transfer system.

SPSD/M was implemented in two versions : SPSD/M-AMDAHL and SPSD/M-PC. SPSD/M-AMDAHL runs on an AMDAHL mainframe under the MVS/OS operating system with a PC interface. The SPSD/M-PC runs on an IBM XT or AT microcomputer under the MS-DOS operating system (scheduled for release in June, 1988). Both versions have the same functionality and command syntax.

SPSD/M is used by economists, statisticians, sociologists and computer scientists in the division, and by related federal and provincial departments and agencies, and universities and special interest groups.

Designed, developed and implemented internally by Statistics Canada, SPSD/M is a user-friendly, widely available and comprehensive tool for tax transfer policy analysis.

4.6. **Transport Canada**

The Aviation Forecasting Division of Transport Canada's Aviation Forecasting Branch produce air passenger/cargo movement forecasts. These serve as input to financial and human-resource planning and to policy analysis.

The Passenger Origin Destination Model (PODM) is an aconometric, national forecasting DSS application that produces origin/destination passenger demand forecasts for over 60 major airports in Canada. The model is enhanced every two or three years, thus recalibration (and, sometimes, respecifying) is necessary to ensure its continuing validity.

POMD is a PC-based system that runs on an IBM XT or AT microcomputer under the MS-DOS operating system. It is used by the planners, financial administrators and airport authorities in the department. The forecasts are also available to interested external clients.

Recognising the need to produce more effective passenger forecasts, Transport Canada designed, developed and implemented PODM in 1977 as one of the cornerstones in the department's Air Administration national forecasting system.

This user-friendly, highly accessible system has provided reliable forecasts (90% accuracy rate) over the past 11 years, and this resource will continue to be used for the near future.

4.7. Energy, Mines and Resources

The Canada Centre for Mineral and Energy Technology (CANMET) is a research and technology development arm of the Department of Energy, Mines and Resources. The range of research activities spans mining, minerals, metals, materials and fossil fuels. CANMET is also working closely with the Canadian industry to develop and evaluate new and useful technologies.

The Simulated Processing of Ore and Coal (SPOC) project is a simulation DSS application initiated at CANMET. The objective is to develop and transfer to the Canadian mineral processing industry a computer-based process for evaluation and optimisation in mining. The methodology follows a step-by-step approach including sampling, material balance calculations, process modelling and process simulation. The process information collected by sampling and represented by the model equations can be used to predict the product of any combination of feed and operating variables within the range for which the model is valid.

The most common application of process simulation is the optimisation of existing flowsheets by searching for the most adaptable process variables to achieve a desired result. It is also used by design engineers to design and modify a flowsheet configuration.

The SPOC project is a PC-based system that runs on an IBM AT or Xt microcomputer under the MS-DOS operating system.

SPOC is used by the Canadian mineral processing industry and in the United States, Australia, Brazil, Chile and France, among others. This system was designed, developed and implemented internally with the help of numerous industrial and academic partners.

In production since 1986, SPOC has greatly assisted mineral processing companies to achieve uniformity of overall production, standardised process and circuit control with reduced costs.

5. FACTORS CONTRIBUTING TO SUCCESSFUL DECISION SUPPORT SYSTEMS

Many design, development and implementation factors contribute to a successful DSS, one that is fully functional, adaptive, user-friendly and integrated. A brief description of the more important factors follows.

a) An adaptive relationship between the user and the builder must be established to design a system based on accurate assessment of end-user needs. Since the traditional system developmet process is inappropriate, an interactive design approach must be used in which the design and implementation are inseparable and evolutionary (S. Alter, 1978). This highly integrated process of design and implemetnation is needed to esnure that, as users learn more about the problem through analysis, implementation and use, their evolving ideas and learning can be reflected in the DSS.

b) The achievement of a successful DSS demands management's commitment, involvement and leadership in addressing human, structural, procedural and technology issues (M.M. Ruprecht, 1984):

1. Human. Adding technology to existing environments often results in fear, stress and resistance to change. Communication to employees about the planning process will do much to alleviate adverse reactions.

2. Structural. Changing the way people work - their traditional roles - requires that management take an agressive positive approach to provide perspective and to allow the transition to be made smoothly.

3. Procedural. The preparation of operating procedures or guidelines will help provide a smooth transition to the new system.

4. Technological. Concerns about networking and technology centre around the degree of integration required to meet the needs of an organisation. These technologies and the skills required to master them need time, training, patience and the active, involved leadership of management.

c) Justifying a DSS to the management of an organisation must be done in terms of effectiveness or value-added rather than in terms of efficiency or cost-displacement measures. Finding and measuring value-added applications are rooted in business objectives and require:

1. a deep understanding of the mission and business processes of each user group;

2. the participation of top management and users at all levels in selecting potential applications critical to the success of the entire organisation; and

3. that the measurement of the value-added benefits of potential applications be relevant, focus on critical business needs and be understood by the decision-makers.

d) The development of a coherent and comprehensive plan to drive the acquisition and use of new technology, information and communication architectures is critical to system compatibility and to the management of organisational transformations precipitated by new technologies. In particular, executives must ensure that incompatibilities among organisational hardware, software, data base and communications do not limit the accessiblity of DSS applications to the vital data bases upon which they depend. As well, the accuracy, timeliness, amount and existence of data are also concerns that merit attention.

e) Human resource management issues, such as changes in the composition, skills and knowledge of the computer organisation, the physical setting of the work environment and appropriate education and training, must be carefully planned and implemented so that new systems can be effectively incorporated into the daily work pattern.

f) Lack of system documentation of assumptions and documentation of input data warrant special attention. All of the "givens" must be available to the operator and to the end-user upon request.

g) Users of DSS applications must be helped to develop a favourable understanding of and attitude toward the human, technological and developmental resources and costs needed to build, operate and maintain such systems.

h) There must be recognition of factors that are not included in the DSS. For example, economic models generally cannot factor in the psychological reactions of the population responding to changes in the economic situation.

i) The systems are only as good as the assumptions they are built on and the data they are provided with. The users of the DSS must constantly challenge the assumptions and strive to provide the DSS with the best input data available. Provision must be made for resources to perform ongoing maintenance, update and evaluation.

Careful attention to these critical factors will determine the success or failure of DSSs in organisations.

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AN INTRODUCTION TO ECOKNOWMICS - THE CONCEPT

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INTRODUCTION

What is ECOKNOWMICS?

ECOKNOWMICS is the acronym for ECOnomic KNOWledge Management, Integration, and Communication System. It is a microcomputer-based expert system that can provide answers to questions about the behaviour of economic entities and can explain why and how it arrived at the answers. It makes use of electronically encoded economic "knowledge" to "understand" the questions, "think" of the answers, and "explain" the reasoning behind the answers.

What kind of questions can ECOKNOWMICS answer?

It can answer questions about economic variables describing the behaviour of economic entities at a certain place and time period. These questions can be classified according to the six discourse types supported by ECOKNOWMICS, as illustrated in the examples below:

1. Factual discourse

What was the Gross National Product (GNP) of the Philippines from 1972 to 1985?

2. Counterfactual Discourse

What could have been the GNP of the Philippines from 1972 to 1985, if the price of oil had remained stable at the 1972 level?

3. Hypothetical Discourse

What could be the GNP of the Philippines from 1986 to 1990, if the external debt remained constant at the 1985 level?

4. Inferential discourse

Why was the GNP of the Philippines in 1984 lower than that in 1983?

5. Procedural Discourse

How is the GNP of the Philippines for 1990 projected?

6. Analytical Discourse

What stochastic model can be used for projecting the GNP of the Philippines using data from 1972?

What are the possible uses of ECOKNOWMICS?

1. Provides a facility for managing and integrating economic information from different sources and communicating this information to individual users cheaply and efficiently using microcomputers.
2. Implements automatically and painlessly standards covering the concepts, the definition of concepts, and the measurement of concepts used in economic statistics research, planning and policymaking.
3. Acts as an electronic "referee" in resolving issues concerning the consistency and accuracy of economic statistics and research results.
4. Allows cost-effective replication and distribution of economic "knowledge" using floppy diskettes or telecommunication networks.
5. Serves as a "one-stop" facility for integrating the work of statisticians, researchers, and policy analysts to support economic planning and policymaking.
6. Bridges the ever-widening chasm between economic statisticians, who need concepts from theories, and theoreticians, who need data from statistical surveys, by providing a common communication tool.

How does ECOKNOWMICS work?

The heart and soul, so to speak, of ECOKNOWMICS is its concept dictionary, which is a collection of formal concept definitions. All operations of ECOKNOWMICS are controlled by the concept dictionary, which is implemented in the form of GURU rule sets.(*)

The formal definitions ensure that : (1) ambiguity in the meaning of the concepts is minimized, (2) consistency among the concepts is maintained, (3) redundancy and overlapping of concepts can be easily identified and made explicit, (4) definitions for concepts are standardized and therefore made comparable, and (5) computers can interpret the definitions and execute operations based on the interpretations. By allowing only standardized definitions of concepts; the concept dictionary serves as a common communications tool for statisticians, researchers, and policymakers.

Using the procedural discourse, for instance, a user of ECOKNOWMICS can trace the conceptual foundations of GNP, down to the concepts used in surveys of establishments. All concepts relevant to the computation of GNP are linked together by logical access paths in the GURU rule sets representing the concept dictionary, which ECOKNOWMICS uses in providing answers to queries.

Because raw data, indicators, accounts and models consist of concepts and the relationships between concepts, they can all be tested for mutual consistency and, if consistent with each other, can be formally intergrated using the concept dictionary. Consequently, models and databases developed by different researchers can be used by ECOKNOWMICS; either singly or in concert, to provide answers to queries.

Can ECOKNOWMICS be used in other disciplines?

ECOKNOWMICS is a generalised tool for conducting empirical studies in the social sciences. It can be used, for instance, for both economics and demography. Alternatively, both concept dictionaries can coexist to support interdisciplinary applications.

(*) GURU is an integrated software development tool from Micro Data Base System (MDBS) Inc. It provides an artificial intelligence environment for developing expert systems such as ECOKNOWMICS.

SOFTWARE DEVELOPMENT PROJECT

Economic data systems serve as the foundation for planning and policy research. Over the years, these data systems have evolved toward increasing standardisation and integration of data to provide users with coherent and consistent views of economic states and activities. The various economic accounting systems, economic indicators, and econometric models are examples of data systems that attempt to provide economic planners and policy makers with convenient "handles" on economic reality.

Each data system, however, has its own set of underlying assumptions that uniquely define the view it provides to users. Each view in turn provides "meaning" to the data. Because of the diversity of assumptions underlying each view, users sometimes find it difficult to integrate data from different views, especially when the meanings of the data are not made explicit.

The statisticians conducting surveys of establishments, for instance, use concepts and assumptions that are different from those used by economic accountants, although the data used by the accountants come from the surveys. Similarly, econometricians estimate their models using data from different views with varying degrees of accuracy and reliability. Perhaps, the difficulty in integrating data is a consequence of the tendency of statisticians, economic accountants, and econometricians to work independently of each other, and their lack of tools for specifying explicitly the concepts and assumptions they use.

The availability of computers is turning out to be a mixed blessing to users of data systems. Undoubtedly, computers have made it easier for users to integrate data physically; computerized databases allow users to store and retrieve data very quickly. The lure of computers, however, has blinded users to possible inconsistencies in the data as they rush to convert to computerised databases. It seems that physical integration has been getting undue attention at the expense of logical integration. This has serious implications for planners and policy researchers, who may want to interact directly with these databases.

The National Economic and Development Authority (NEDA), for instance, has several computerised databases and models that can be used to support planning and policy research. Using these databases and models, however, requires intermediaries, persons who understand what the different records, files, and programs inside the computer mean in terms of the data and modelling needs of planners and policy researchers. Working with these intermediaries requires additional time and effort; working without them is practically impossible.

The ideal situation would be for planners and policy researchers to be able to interact directly with the computerised databases and models without having to go through intermediaries. The proposed solution is to build an economic knowledge base embedded in an expert system for planning and policy research. The economic knowledge base effectively integrates logically and physically in one place the databases and models; the expert system effectively replaces the intermediaries.

OBJECTIVES OF THE SOFTWARE DEVELOPMENT PROJECT

Overall Objective : The project aims to develop a prototype software system that can demonstrate how microcomputers and Artificial Intelligence (AI) techniques can provide cost-effective solutions to the problem of managing and integrating economic data and models to support planning and policymaking. The prototype system will be evaluated by NEDA in terms of its potential use as an "intelligent assistant" to help improve the data gathering, data management, modelling, and decision-making capabilities of planners and policy researchers. The results of the evaluation will guide the possible conversion of the prototype into a fully operational system.

Specific Objective : A prototype microcomputer-based expert system will be built to test the feasibility of using microcomputers and AI techniques in planning and policymaking. This prototype expert system will embody economic knowledge or expertise for conducting macroeconomic studies. In particular, the expert system will provide planners and researchers with facilities for identifying and diagnosing balance-of-payments problems and for simulating the effects of alternative policy solutions. The economic planning and research staff of NEDA will test and evaluate the system.

PROTOTYPE VERSION OF ECOKNOWMICS

The prototype version of ECOKNOWMICS will provide the following functions :

a) **build scenario** - allows users to specify factual or hypothetical scenarios, which can be used for identifying policy problems or for evaluating policy solutions (Figure 1 shows the major components used in building ECOKNOWMICS scenarios). A scenario is a collection of outcome variables and their values that describe the changing states of the economy over a period of time (time paths of variables).

The outcome of values may be actual, assumed, or generated. ECOKNOWMICS automatically ensures that the scenarios being built are internally consistent by subjecting them to relevant economic-accounting and econometric-relationship constraints as well as to rules-of-thumb on feasible and reasonable values of economic variables. The semantics of a scenario and its component variables is made explicit right down to the lowest level : raw observations from statistical sample units. Users have access to all the underlying concepts and assumptions of data and models used in generating scenarios.

b) **Identify problem** - allows users to scan a specified scenario and detect problem situations based on user-supplied critiera, e.g. planning targets. This function can be invoked to deal with either factual or hypothetical scenarios generated by simulation or forecasting models. The users can provide the criteria for determining what a problem situation is for a specified scenario and can revise the criteria anytime within an ECOKNOWMICS session.

c) **Perform diagnosis** - provides users with problem diagnoses based on accounting or econometric relationships that link causes and effects.

Users may assign certainty factors to scenarios to indicate the extent of belief of users as regards the accuracy of the data or the probability of its occurrence. In case of uncertain data, the diagnoses will similarly be uncertain. Algorithms for computing certainty factors under various assumptions allow users to "fine-tune" results.

d) **Find solution** - provides users with policy solutions that are appropriate to the identified policy problems and diagnoses. Each solution will have assumptions that have to be satisfied either by conditions defined in the scenario or by conditions postulated by users. The stock of standard policy solutions will be built from published studies.

e) **Update knowledge base** - allows users to modify existing data and models or add new data and models. Obsolete or invalid data and models can also be deleted. The prototype knowledge base will include only data and models for balance-of-payments studies.

Functions to be implemented in future versions of ECOKNOWMICS include report-generation and regression analysis (single and simultaneous-equation models).

SOFTWARE DESIGN APPROACH

A major consideration in the design of ECOKNOWMICS is the need to provide extremely user-friendly interfaces; the users have to be shielded from the technical complexities of the hardware and software systems of the computer. To attain this, ECOKNOWMICS provides users with very high-level objects, functions, and operators (refer to Figure 2). The higher the level of an object, the closer it is in meaning to the objects in the domain of expertise stored in the knowledge base, and the farther it is from the objects in the domain of computer hardware and software.

The major functions will be implemented as options in the Main Menu. The user objects will be organized as a hierarchy with SCENARIO at the top. A SCENARIO may consist of one or more VIEWS and each VIEW may have one or more DESCRIPTOR variables. Users may specify one or more TIME PATHS for a DESCRIPTOR, e.g. one factual TIME PATH and one counterfactual TIME PATH for comparative analysis. Each TIME PATH may consist of one or more VALUES for the years, semesters, quarters, months, etc. of the TIME PATH.

The underlying records, files, programs, rule sets, and other internal objects of ECOKNOWMICS will all be transparent to the users. Only those users who are responsible for updating the knowledge base will need access to these internal objects.

The GURU artificial intelligence environment from Micro Database Systems, Inc. (MDBS) will be used to develop and implement ECOKNOWMICS (1) The databases will be implemented as network and relational database systems; the models will be implemented as structured rule sets. The GURU inference engine will provide the control mechanism for processing the databases and rule sets.

Actual data will be obtained from published Balance of Payments and National Income Accounts and from time-series data of the National Census and Statistics office and the Central Bank. The Bacha framework for balance-of-payments analysis will be used for diagnosing identified problems and suggesting policy solutions. (2)

DEFINITION OF SOME ECOKNOWMICS OBJECTS

Label : One or more characters organised as a string and used as a single unit.

Identifier Label : Allows representation of a concept

Value Label : Allows representation of the outcome of a measurement procedure for a concept.

Time Point : A set consisting of all Identifier Labels of one concept, one Value Label of that concept, all Identifier Labels of a particular time concept, and one Value Label of that time concept. Allows associating alternative names of a concept with an outcome of that concept for one point in time.

Time Path : A set consisting of Time Points having the same concepts and Identifier Labels but different and consecutive Value Labels of the time concept. Allows associating alternative names of a concept with every outcome of that concept for consecutive points in time.

Descriptor : A Time Path attached to a View and unique for that view. Allows alternative interpretations of a Time Path.

View : Unique set consisting of one or more Descriptors. Allows logically consistent interpretation of one or more Time Paths. Allows building alternative Scenarios using different combinations of Views.

Scenario : User-built and internally consistent set consisting of **views**. Allows comparison and evaluation of alternative policy assumptions and outcomes represented by different Scenarios.

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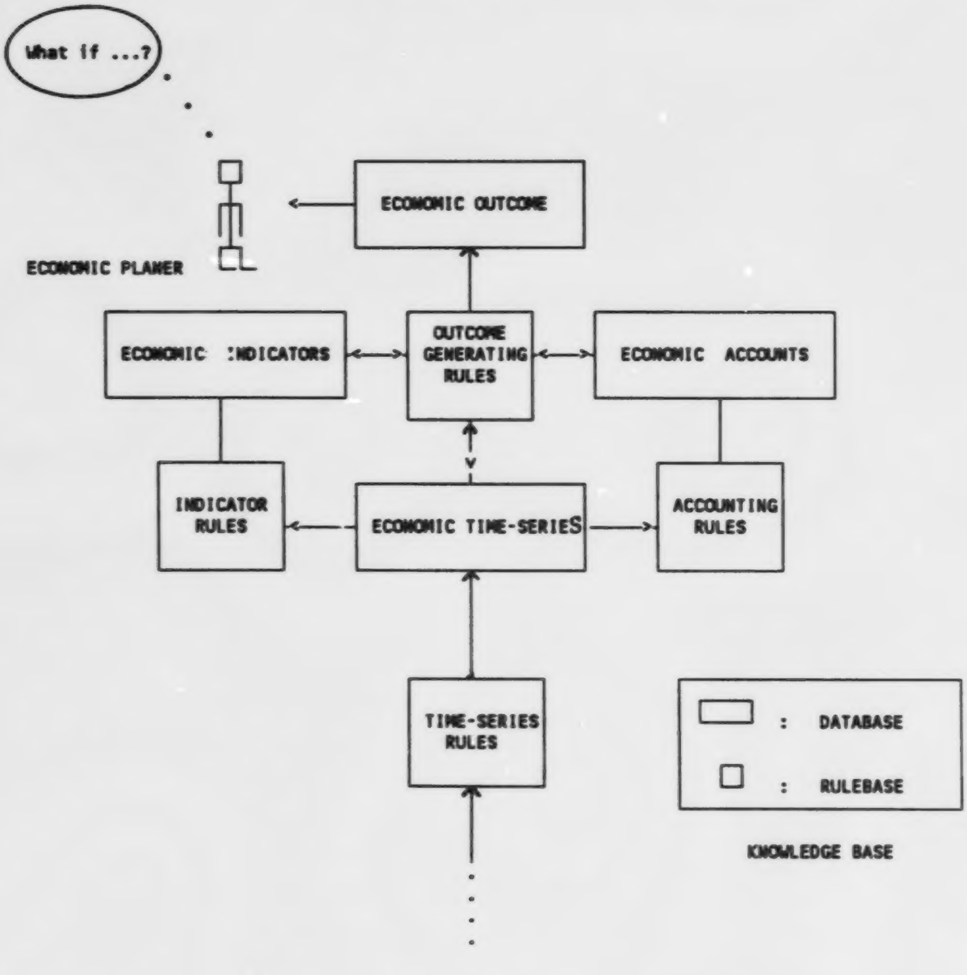
(1) For a detailed description of GURU, please refer to Holsapple and Whinston, **Manager's Guide to Expert Systems Using GURU**, Dow Jones-Irwin, 1986

(2) Please refer to Remolona, et. al., "Foreign Debt, Balance of Payments, and the Economic Crisis of the Philippines in 1983-84" in **World Development**, Vol. 14, N° 8, pp. 993-1018, 1986.

ECOKNOWMICS
ECOnomic KNOWledge Management, Integration and Communication System

Figure 1


What if ...?
ECONOMIC PLANER
ECONOMIC OUTCOME
ECONOMIC INDICATORS
OUTCOME GENERATING RULES
ECONOMIC ACCOUNTS
INDICATOR RULES
ECONOMIC TIME-SERIES
ACCOUNTING RULES
TIME-SERIES RULES
: DATABASE
: RULEBASE
KNOWLEDGE BASE

REQUEST TO "INTELLIGENT ASSISTANT": Build Scenario

SCENARIO ID: SC00001

VIEW: Indicator

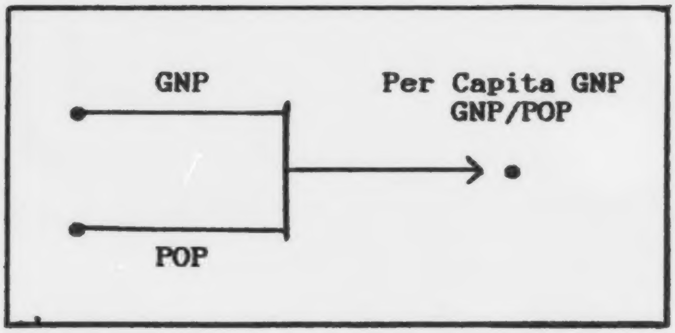
SUB-VIEW: Production

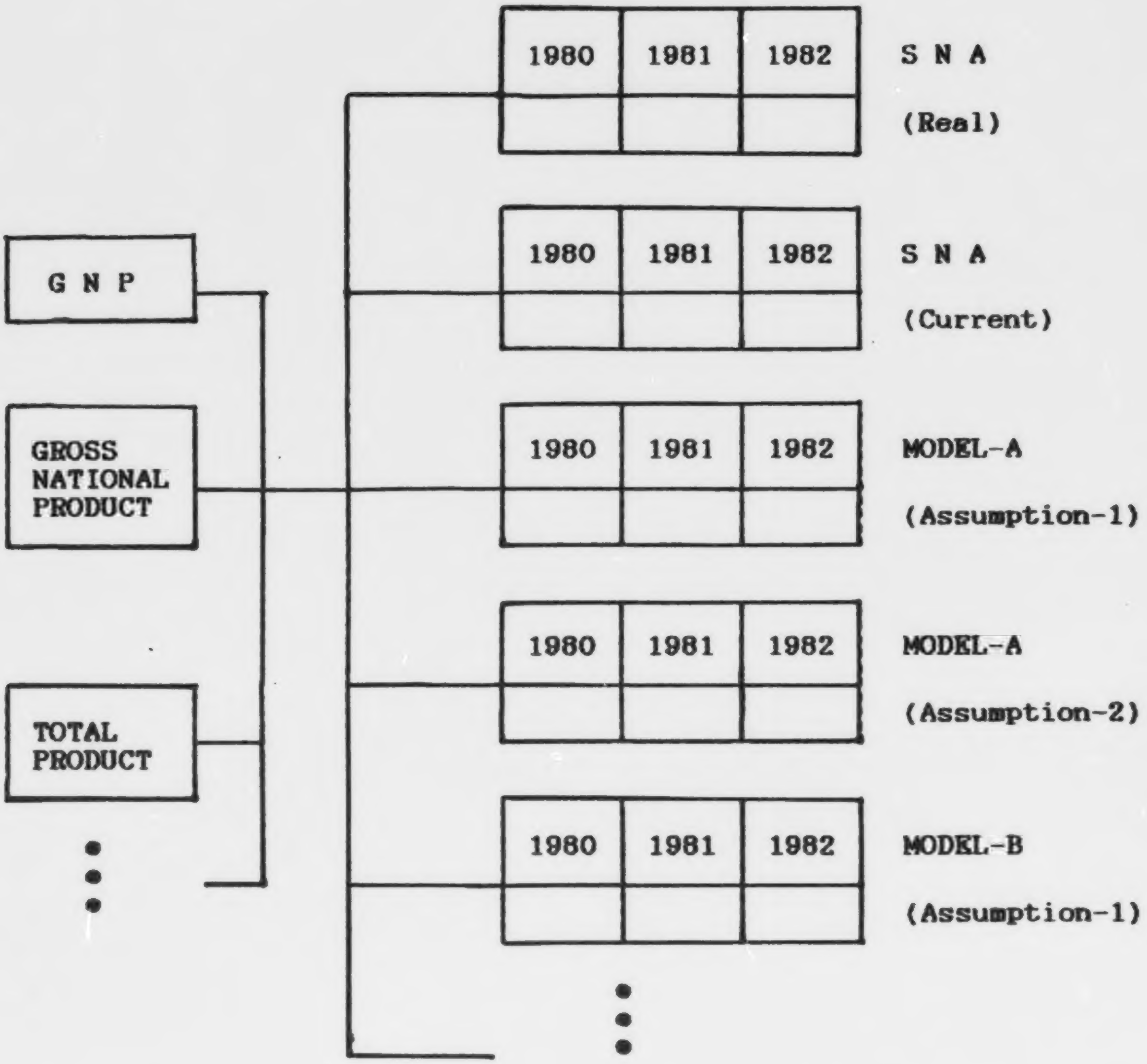
DESCRIPTOR: Real Per Capita GNP

TIME PATH START YEAR: 1980

TIME PATH END YEAR: 1990

OUTPUT OF "INTELLIGENT ASSISTANT": Automatically-built scenario with full documentation and explanation of how the scenario was built.




G N P
GROSS NATIONAL PRODUCT
TOTAL PRODUCT
1980
1981
1982
S N A
(Real)
S N A
(Current)
MODEL-A
(Assumption-1)
MODEL-A
(Assumption-2)
MODEL-B
(Assumption-1)

ECONOMIC PLANNING DATABASE

- o Multiple Identifier Labels for the Same Concept
- o Multiple Measurement Procedures
- o Multiple Assumptions
- o Minimal Documentation

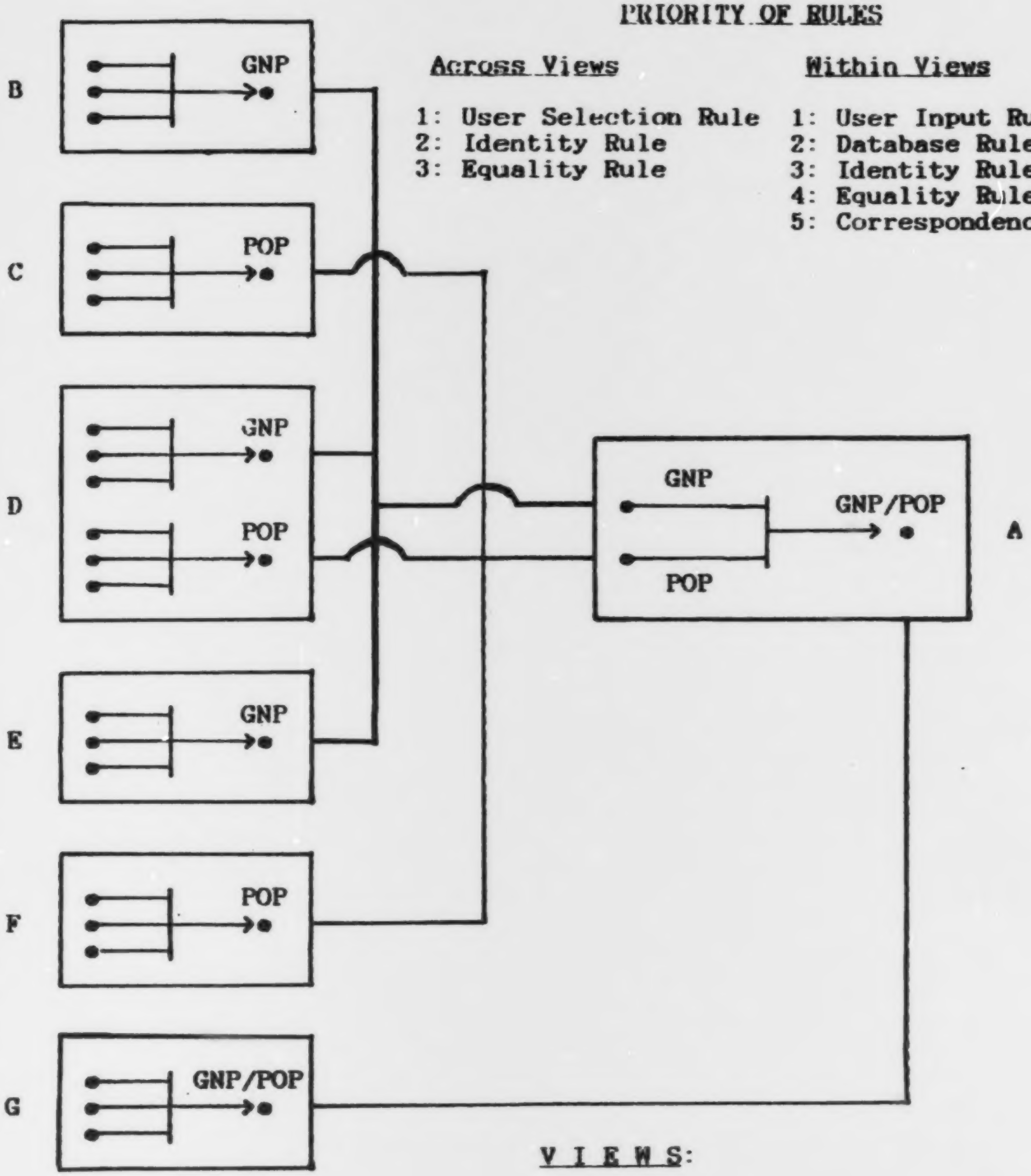
PRIORITY OF RULES

Across Views

1: User Selection Rule
2: Identity Rule
3: Equality Rule

Within Views

1: User Input Rule
2: Database Rule
3: Identity Rule
4: Equality Rule
5: Correspondence Rule


B
GNP
C
POP
D
GNP
POP
E
GNP
F
POP
G
GNP/POP
GNP
GNP/POP
POP
A

VIEWS:

A : INDICATOR
B : ACCOUNT
C : ACCOUNT
D : MODEL
E : MODEL
F : MODEL
G : MODEL

RULES FOR GENERATING VALUES OF DESCRIPTORS:

USER INPUT RULE

IF : Generation of value is manual
THEN : Obtain value from user

DATABASE RULE

IF : Value of descriptor exists in the database
THEN : Obtain value from database

IDENTITY RULE

IF : Consumption (C) is known and
Investment (I) is known and
Government Expenditures (G) is known
THEN : Gross National Product (GNP) = (C) + (I) + (G)

EQUALITY RULE

IF : Capital Stock (K) is known and
Employment (N) is known
THEN : GNP = -1,284.25 + 0.1955(K) + 1.4315(N)

CORRESPONDENCE RULE

IF : Value of GNP is unknown and
cannot be generated within the view
THEN : Find other views that can generate the value of GNP

RULES FOR SELECTING VIEWS:

USER SELECTION RULE

IF : Selection of view is manual
THEN : Obtain view identifier from user

IDENTITY RULE

IF : View generates value of descriptor using an identity
THEN : Select the view

EQUALITY RULE

IF : View generates value of descriptor using an equation
THEN : Select the view

LARGE SYSTEM CYBERNETICS AND MULTILEVEL INTELLIGENT MANAGEMENT SYSTEM

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1. INTRODUCTION

With the development of society toward informatization and systematization, there emerge many large scale information systems, such as national or provincial economical information systems, large scale computer data communication networks, etc. This is not only the result of development of information science, computer science and communication science, but also the demand of modern society.

Therefore, it is necessary to study the methodology of large scale information systems in order to ensure its reliability, improve its benefit, and save its expenses on implementation and management.

"Large System Cybernetics", being a new branch of cybernetics, deals with the analysis and design methodology of large scale control and information systems. From the viewpoint of large system cybernetics, this paper probes into the designing methodology of large scale information systems.

2. LARGE SYSTEM CYBERNETICS

"Large System Cybernetics" was first put forward by a Chinese scholar. Dealing with the analysis and design methodology of large scale system, it is a new branch of cybernetics, a technological science which lies between system science and engineering.

Qian Xuesen, the well-known Chinese scientist on system science, proposed that "Large scale system theory should bring forth new ideas", and pointed out "It is a breakdown in cybernetics to use expert system approach to deal with some difficulties in large scale system engineering".

Large system cybernetics is produced by combining large scale system theory with artificial intelligence, as shown in Figure 1.

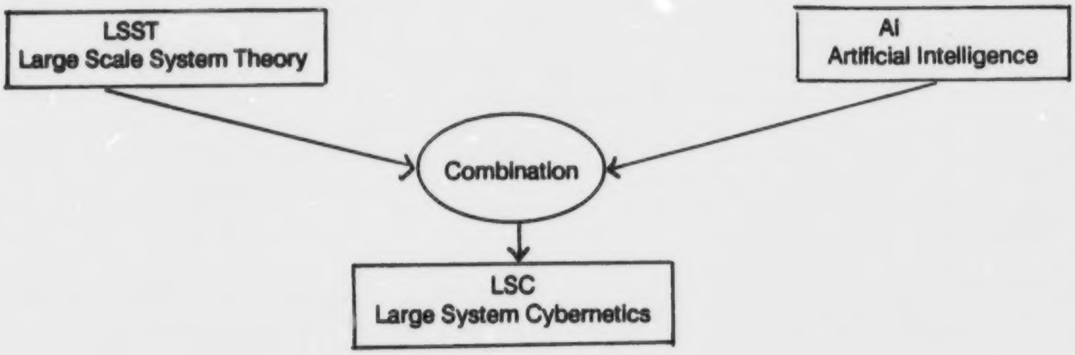

Figure 1 : The Production of LSC

The research objects of LSC are large systems in various fields such as engineering, social-economical, biological, and ecological systems. It analyses the generality and speciality of various large systems from the viewpoint of control and information with emphasis on the control, management, and decision-making, especially on the transmitting, transforming and processing of information.

There are three essential parts in LSC:

1. Analysis of LSS. That means the analysis methodology of large scale systems, including qualitative and quantitative, static and dynamic, structural and functional, macro and micro analysis. It aims at providing a scientific basis for the improvement of a system's state and properties of operation. For example, the analysis of passability of aninformation structure.

2. Synthesis of LSS. That means the design methodology of the LSS to be established, including structure and parameter synthesis. It aims at the improvement of reliability and performance/price ratio and the realization of optimization, coordination and intellectualisation of systems, such as "the most economical information structure synthesis", etc.

3. Generalised Modelling. This approach provides the generalised models which are needed for the analysis and synthesis of LSS. The types of general model include qualitative and quantitative, knowledge and mathematical, static and dynamic, structural and functional models, such as heuristic-optimizing models.

LSC has several features, such as:

1. Combination of Heuristics and algorithm. Knowledge-based heuristics and model-based algorithm can be combined to take into account both qualitative and quantitative analysis. This approach can be used to avoid or alleviate "Combination Explosion" and "Curse of Dimentionality", benefit the solving of large and complicated problems of systems in the incomplete information environment (uncertainly-known and uncertainty).

2. "Man-Machine" Harmonization. It is required to take the "Man-Machine" intelligence combination approach in order to deal with the control, management, and decision-making of LSS properly and effectively. According to this approach, the initiative, originality and flexibility of human beings should be given full play on the one hand in the control, management and decision-making process of systems, and on the other hand, the achievements of artificial intelligence (machine intelligence), computer science and engineering. They should also be made adequate use of in order to realize "Man-Machine" harmonization and user friendship.

3. "Human Imitation". The control and information system of the human body is the most perfect LSS. It is the result of a long period of evolution of living things, natural elimination, and environment creation. It has many distinguished features in structure and function, such as the combination of the fast and "Region Division" control of the nervous system and the slow and "Function Division" control of body fluids, the hierarchical multilevel structure with stratified feedback mechanism, the transmitting, tranforming, and processing of information with the combination of continuous and discrete, parallel and eries pattern, and function of the system with self-optimization, self-learning, self-adaptation, self-organisation, self-restoration, and self-reproduction. Therefore, "Human Imitation" is useful to improve the established engineering system or design a new one from structure to function.

4. "Gray Box". It means the combination of the "black box" with the "white box" and the combination of macro with micro approach. This approach can benefit both macro external and micro internal analysis, meet the demands of analysing large scale systems and each of its sub-systems at different levels. For example, Multistratum State Space and Multilayer Generalized Operator can be used to analyse LSS at different levels, making the structural and functional design closely matched and improving the harmonisation and coordination of the system.

3. THE OPEN PROBLEM OF INFORMATION SYSTEMS

The applications of computers in public management information systems, especially in economical information systems, have been greatly and broadly developed, as shown in Figure 2

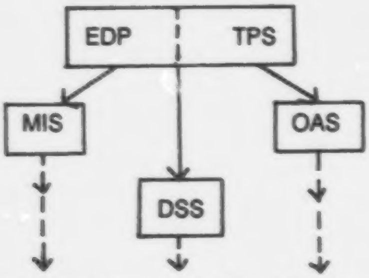

Figure 2 Development of Information System

EDP - Electronic Data Processing
TPS - Transaction Processing System
MIS - Management Information System
OAS - Office Automation System
DSS - Decision Support System

But many problems still emerge with the development. For example:

1. "Multilevel" Problem. Modern large scale information systems are required to provide multilevel information services, including

a) Highlevel, such as strategic, overall and long term prediction, planning, decision-making and cooperation.

b) Middle level, such as tactical, partial and middle-term plan cooperation and dispatch management

c) Low level, such as short term and daily office routine processing and operating. Generally, DSS, MIS, and OAS emphasize separately on high level, middle level and low level.

2. "Multiaspect" Problem. Modern large scale management information systems are always required to provide information services of multiaspect. For example:

a) Economical aspect, such as finance, money, accounting, trade, tax revenue, market and resources.

b) Social aspect, such as population, environment, traffic, secure, personnel, culture and education.

c) Technical aspect, such as metallurgy, chemistry, machinery, electronics and material.

The information services of the above aspects concern not only related data, but also knowledge of various specialities and therefore demand knowledge-base as well as database. But, usually the information system like OAS, MIS, and DSS only have database for the use of information inquirement and no expert consultation function based on knowledge basis is available.

3. "Multiphase" Problem. Modern information systems are required to provide information services for the whole process of decision-making which generally include: :

a) Task Definition

b) Information Processing

c) Scheme Design

d) Selection of Decision

e) Evaluation of Effect.

In the processes described above, there are not only structured problems which can only be tackled with qualitative approach based on knowledge reasoning, or with the combination of the former and latter. However, most information systems at present time provide only quantitative means based on mathematical models and lack qualitative reasoning based on knowledge models.

4. "Man-Machine" problem. User Friendship and Man-Machine Harmonization play a key role in the effort of improving the operating efficiency and benefit of information system. Nevertheless, current systems can only provide the user with normal man-machine interface and it is urged to develop intelligent man-machine interface, realize direct "man-machine dialogue" by means of character, image and natural language or limited natural language. With the realization of man-machine intelligence combination, the intelligent level of machine in information systems can be greatly improved based on proper task assignment between man and machine.

4. Intelligent Management System

In order to solve the problems existing in information systems, we proposed the scheme of "Intelligent Management System (IMS)" from the view of large system cybernetics, as shown in Figure 3.

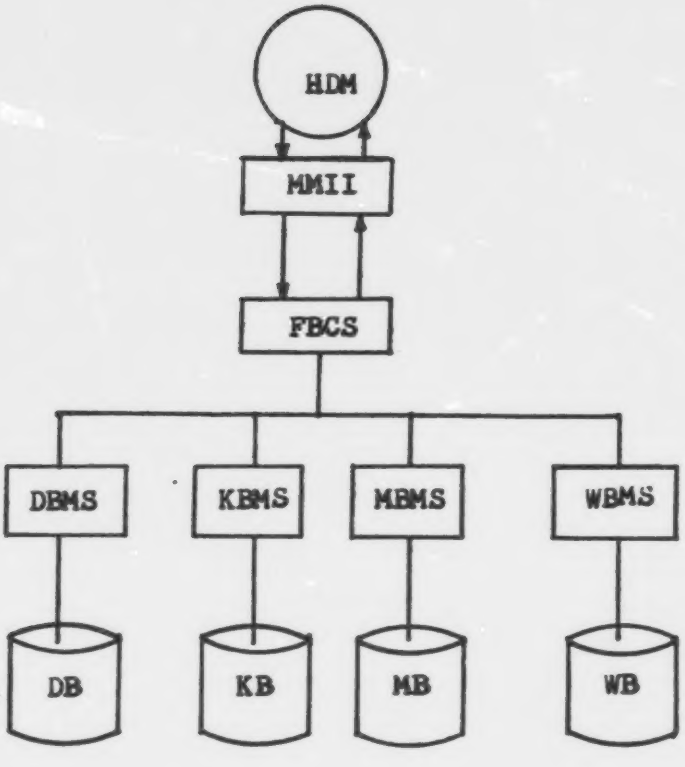

Figure 3 The Scheme of Intelligent Management System

HDM - Human Decision Maker
MMII - Man-Machine Intelligent Interface
FBCS - Four Bases Cooperation System
DB - Data Base
DBMS - Data Base Management System
KB - Knowledge Base Management System
KBMS - Knowledge Base Management System
MB - Model Base
MBMS - Model Base Management System
WB - Way Base
WBMS - Way Base Management System

The main ideas of intelligent management systems are as follows :

1. Generalized Modelling. For the purpose of providing multilevel, multiaspect and multiphase information services and supports, it is needed to build generalized model on the basis of large scale system cybernetics. The generalized models include :

a) Mathematical models, such as the models of operation research, numerical economics and economics cybernetics, which are usually described by algebra equations, differential equations and difference equations.

b) Knowledge models, such as qualitative models of psychology, sociology, behaviour science, as well as the knowledge model of those specialised disciplines, including theoretical and experienced knowledge. These models can be expressed with the knowledge representing method of artifical intelligence, such as production rules, semantic network, frame, etc.

c) Structure models, such as the graph models used for describing information flow, material flow, energy flow and for expressing human relationships and organisation structures. Graph model, although used mainly for expressing qualitative relations, can also be used for describing some quantitative relations by means of assigning values.

Based on general models, many management decision-making problems can be described and analysed with quantitative or qualitative, macro or micro, static or dynamic approach and the information services of multilevel, multiaspect and multiphase can be provided.

2. "Four Bases Cooperation". With respect to generalised modelling, the software structre of "four bases cooperation" is adopted in intelligent management systems. They are :

a) Data Base, storage and management of all kinds of concerned numerical information and statistical data

b) Knowledge Base, storage and managemnent of required mathematical model and structure model as well as related model parameters.

c) Model Base, storage and management of required mathematical model and structure model as well as related model parameters.

d) Way Base, storage and management of required data processing method, knowledge reasoning method, model resolution and optimization method belong to either heriusic or algorithm.

With the use of "four bases cooperation system (FBCS)", database, knowledgo base, model base and way base can cooperate with one another and provide users with multifunction information services, such as information retrieving, expert consolation, model prediction, optimising analysis, numerical calculation and knowledge reasoning. As a matter of fact, the structure of the four bases is the software realization of general models.

3. Man-Machine Harmonization. On the design of IMS, user friendship and man-machine harmonization are realized through intelligent man-machine interface. Included in this interface are :

a) "Man-Machine" Natural Dialogue.

Natural or limited natural language will be adopted and the man-machine dialogue will be realized by the use of oral or script pattern.

b) Friendly "Man-Machine" Interaction.

Controllable double-direction communication between user and machine will be used. The machine will be capable of helping the user to use four bases, to answer questions and to make explanations to users. Users can understand the basis of machine reasoning, input heuristic information and control the intermediate process of machine operation.

c) "Man-Machine" Task Assignment.

It means that the machine will be mainly in charge of certain types of tasks such as momory, calculation, and information retrieval, while human beings will be more responsible for the uncertain type task which demands flexibility, originality, and initiative.

d) "Man-Machine" Intelligence Combination.

With this approach, not only can proper task assignment between man and machine be realized, but also the intelligent level of machine can gradually improve by means of machine learning with man-machine interative pattern. Therefore, IMS is the system of man-machine harmonization and intelligence combination.

5. Developing System.

Intelligent management system is the system that opens to the developer and the user. The contents of four bases can be unceasingly modified, expanded, and renewed with the help of intelligent man-machine interace, the cooperation and management system of four bases. For example :

a) Knowledge Acquisition

New knowledge, models, methods, as well as data, can be added into four bases by user or expert through intelligent interface.

b) Model Constructure

With the help of four bases cooperation systems, not only can the models in the model base be transferred and used, but the new model can also be constructed according to the user's requirements.

c) Machine Learning

A learning program will be put into the four bases management system. With the function of expert instruction or self-teaching, the prorgram can be used to make revision, expansion and renewals to four bases while the integrity of the four bases can be ensured.

4. Large Scale Information System

The idea, viewpoint and approach of LSC and IMS have been applied to the design of some large scale information systems, such as the overall design of a large scale economical management information system and the office information system of the governor in a province.

The key points of large scale information system design are as follows :

1. Structure Design

The following issues should be taken into account for the design of an information system structure.

a) Adaptability of structure

The structure of the information system should adapt to the structure of the object system being served. For instance, the structure of economical information system should be adapted to the organisation structure of economical management. According to the analysis of large system cybernetics, all the modern large scale organisations of economica managment have the structure of hierarchicacl multilevel, that is, the combination of centralized and decentralized structure. This is the main form optimum seeking structure generally adopted by various kinds of LSS. But some structure deformations may take place in different systems. Therefore, the structure of information systems should have flexibility under the circumstances of economical system reform of the country in order to adapt to the structure reform of economical management organisation.

b) Reliability of structure

The reliability of the information system is the most important index to be considered, and the reliability of structure is the basis of system reliability. With the use of structure analysis approach of LSSC, the information passibility and structure reliability of the system can be examined, judged and compared. It has been shown that the "multilevel hierarchical structure has super reliability by comparing three essential structure schemes of LSS.

c) Economy of Structure

The problem of structure economity should be considered for the purpose of saving investment and raising the benefit/price ratio. "The most economical structure synthesis" approach based on LSC can be employed to make structure design of information networks and the structure scheme with the least investment on facilities can be selected. This means "the most economical structure scheme", or "the smallest system scheme".

d) Structure Optimization

There might exist conflicts among the structure adaptability, reliability and economy. For instance, the equipment used for improving reliability will increase the total spending. This situation can be described as a multi-aim decision-making problem which can be solved with the heuristic-optimizing approach. The idea of the approach is making a compromise between conflicting factors and selecting optimized or satisfied structure schemes.

2. Function Design

The functions of information systems, especially management information systems, can be summed up to three aspects with regards to applications.

a) Transaction Processing, such as the management of Office facilities, the processing of report forms and the scheduling of meetings.

b) Information Management, including the acquisition, transmission, transformation and utilization of various kinds of information.

c) Decision support

This means the feasibility analysis of management decision and the selection of optimal or satisfactory schemes from all the feasible scheme with the use of heuristic-optimizing approach which is based on generalised model. Only with the functions described above can large scale information systems, which in fact include all the main functions of OAS, MIS, and DSS, provide the information services and supports of multilevel, multiaspect and multiphase for every level, every aspect and the whole process of management decision making.

According to the above discussion, the structure and function pattern of the large scale information system is shown in Figure 4.

Figure 4 is a multilevel information system based on IMS, the characteristics of which are as follows :

a) Hierarchical Multilevel Structure

The structure of hierarchical two level is shown in Figure 4. The upper level is the master system, such as the information system at provincial level. The lower level is the slave system, such as the information system at the city level. This structure of "centralized-decentralized" has the property of "region division". However, be it a master or slave system, all of them have the function of transaction processing, information management and decision support, which demonstrate the "task division" property.

b) Multilevel Comprehensive Function

Both master and slave system have the multilevel comprehensive functions of transaction processing, information management and decision support which correspond to the composite functions of OAS, MIS and DSS, and both can therefore provide information services of multilevel, multiaspect and multiphase.

c) Multilevel Intelligent Management System

Both master and slave system are intelligent systems which are based on four base co-operation and intelligent man-machine interface.

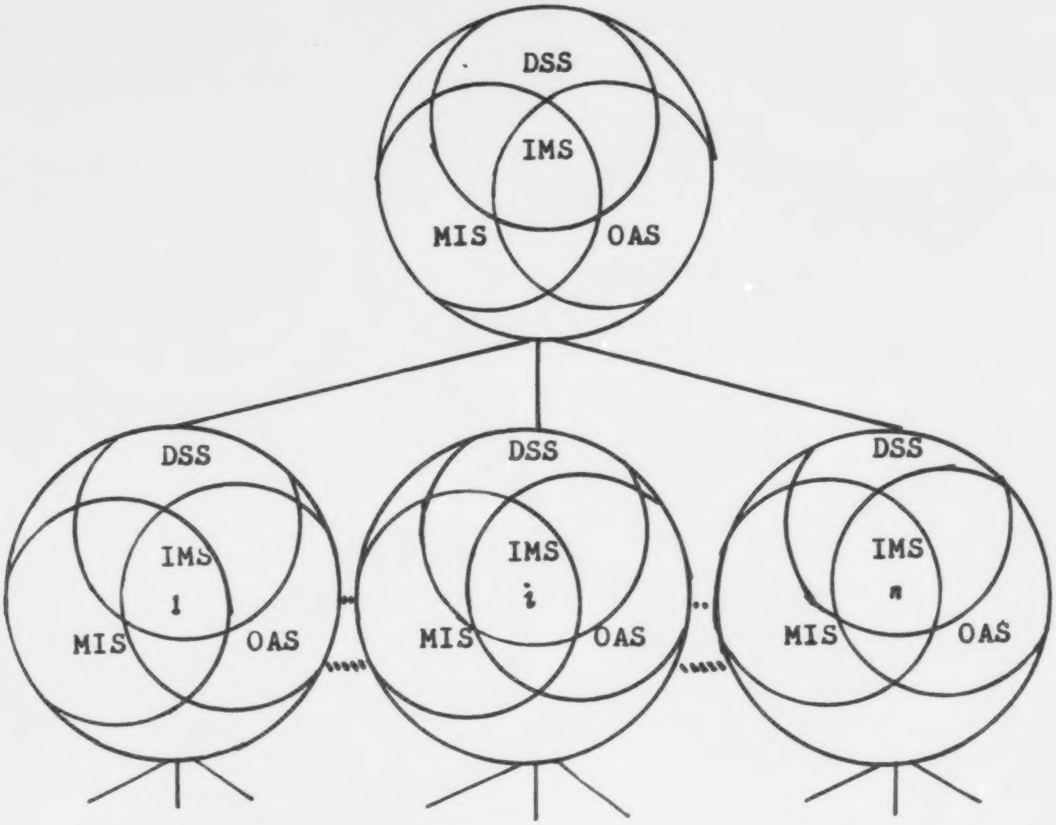

Figure 4 Large Scale Information System Multilevel Intelligent Management System

6. Conclusions

We conclude that :

1. Large system cybernetics can be applied to the design and implementation of large scale public management information systems.

2. The intelligent management system based on four base co-operation and intelligent man-machine interface represent the developing trend of modern computer-aided management information systems.

3. The multilevel intelligent management systems with multilevel hierarchical structure and composite functions provide a new pattern for the design and implementation of large scale management information systems.

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CHINA'S MACROECONOMIC MODEL SYSTEMS (PROJECTION AND CONSTRUCTION)

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INTRODUCTION

China's macroeconomic model system consists of two economic model systems of two levels. The first system is the state-region economic model system, the second system is the state-sector economic model system.

In the state-region model system of two levels, models of state level and models of provincial (or municipal) level are interlinked. All models of state level in this system form the main system of models. All models of provincial (and municipal) level in this system form the subsystem of models.

In the state-sector model system of two levels models of state level and models of sectoral level are interlinked. All models of sectoral level in this system form the branch system of models.

In order to provide a suitable and convenient operating circumstance for all economic models, an Economic Equation Bank and its management system were established in order to edit and solve models is the use of software package TROLL, rented from MIT since 1985. Establishing transforming capacity between TROLL files and Bank files is very useful for model-builders and model-operators.

THE SCHEME OF THE STRUCTURE OF CHINA'S MACROECONOMIC STRUCTURE

1. The main system of models at state level

The economic models at state level describe the change and development of the national economy and its overall balance. In these models are only used aggregated at state level economic variables. Into this main system enter:

. China's quarterly macroeconomic model (econometric model)
. China's annual macroeconomic model (econometric model)
. China's medium-long term macroeconomic model (dynamic input-output model combined with stochastic equations).

The main function of the quarterly model is to forecast the development of China's economy and analyse the effects of implementing some short-term economic policies. In the construction of the quarterly model seasonal adjustment techniques are applied.

Forecasts of annual change of national economy are usually made by using the annual model, at the same time this model has already been used several times to test the overall balance of the state economic plan.

For working out a five-year plan or programming economic development over a long period the medium-long range model is needed in which China's input-output table compiled in 1982 on the basis of economic activities in 1981 was used. This model is rather large in scale and contains about 900 equations. By the end of the year 1988 China will have compiled a new input-output table concerning China's economy in 1987. After this the new version of the medium-long term model will be completed.

2. The state-region model subsystem

Implementing macroeconomic management of two levels (state level and provincial level) is one of the tasks of the planning mechanism reform. To support policy-making to coordinate interests among state and provinces (municipalities) and to disaggregate the development goal of national economy is to set up the state-region economic model subsystem.

In this subsystem there are 28 models of distinguished provinces and municipalities directly under the central government. All these models are econometric. In the subsystems there are over 2000 equations altogether and every provincial (or municipal) model has an average of about 60 equations. These subsystems and models are now stored in the mainframes of SEIC (the State Economic Information Centre).

From the beginning of 1986 many provinces and municipalities had started to construct their own macroeconomic models, and at the end of 1987 all 25 provinces and 3 municipalities had finished this work. Several provinces (for example Qinhai, Sichuan, Shandong, Hubei, Inner Mongolia, Tianjin) used their models to calculate main economic targets in annual planning or to test comprehensive balance of local economic development.

Twenty eight provincial (and municipal) models are standardised in technical aspects : names and abbreviations of several variables are unified, these provinces and municipalities are coded correspondingly, the format of equation files, coefficient files, statistic test files, exogenous variable files, endogenous variable files, simulation result files and data files are normalized.

Over 2000 equations of this subsystem are managed and stored in the Economic Equation Bank. For each equation the bank gives some important information : for instance, name of equation, names of explained and explaining variables, time series of data, its sample period, coefficient values and its T estimations, F, DW estimations for equations and error square and etc.

In this subsystem are also included three zonal models reflecting mutual connection and impact of economic development in three great zones (Eastern Zone, Central Zone, Western Zone).

In the state-region model subsystem linkage among models is a difficult problem. Last year linkage among models of three great zones by means of transmitting productive factors (energy products for example, oil, coal, electricity flow from West, Center to East, some light industry products and machine tool flow from East to Center and West) was realized and transmitting fiscal capital (from East to Center and West). At the same time the state model is also interlinked with zonal models using multi-objective programming methods.

The planning process in China in fact is a consultative process under the guidance of the principle of democratic centralisation. This process is simulated in the linkage of the state models with provincial and municipal models.

3. The branch model system of sector level

China's macroeconomic operating mechanism has been changing step by step accompanying deepening and expanding economic system reform. Function and responsibility of government ministries and commissions are changing continuously. Because of this, the branch system would be projected according to the sectors of social economic activities, but not to government sectors.

In the branch model system of sector level there are seven model classes which correspond to the key economic links of expanded social material reproduction.

a) Basic domestic economic environment model class :

. model of population growth and structure
. model of labor and qualified personnel
. model of environment pollution and its production

b) Basic international economic environment model class:

. China's model for world Project Link and ESCAP Link
. China-Hong Kong trade interlinked model
. China-Japan trade interlinked model
. China-America trade interlinked model
. China-Soviet Union trade interlinked model

c) Expanded reproduction model class:

. industrial production model
. agricultural production model
. transportation model
. energy model
. fixed asset investment model

d) Allocation of national income model class

. model of national income
. fiscal model
. model of social insurance

e) Consumption model class

. model of consumption structure
. model of consumption demand for household groups with different income

f) Social circulation model class

. commerce and market balance model
. foreign trade model

g) Economic management and regulation model class

. price model
. financial model
. debt model

Almost half of the above-mentioned 23 models of the branch system have already been built and the rest are being constructed. During the seventh five year plan period (from 1986 to 1990) all these models should be finished and interlinked. The State Planning Commission, the State Commission of Science and Technology, the Peoples' Bank of China, the Ministry of Finance, the Ministry of Commerce, the Ministry of Foreign Trade and other forecasting institutions take part in researching these models.

THE ROLE OF THE MANUAL INFORMATION NETWORK IN THE CONSTRUCTION OF THE CHINA ECONOMIC INFORMATION SYSTEM

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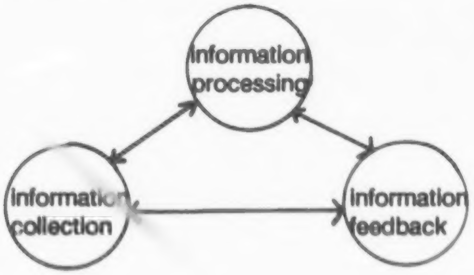
I. INTRODUCTION

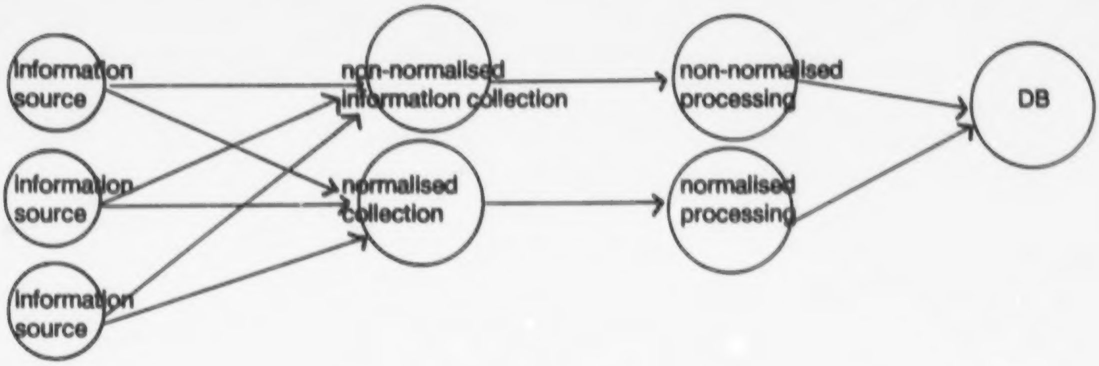
An information system is a system which exists in any organisation. It is a complex system, infiltrating every part of the organisation, involving the control, decisions and management of the system, just like the nervous system of the human body. It consists of many people, and departments. Like any other system, it has its characteristics. Compared with the computer operation system, compiling system, etc., it has more social and human factors. The problems of man-machine interface and co-operation of people and computers in the system are more conspicuous. Therefore, unlike the development of a software system, the development of information systems, especially economic information systems (EIS) requires more relations with people. The function of information systems include collecting, storing processing and transmitting of information.



A modern information system consists of a main system, subsystems and sub-subsystems. The materials that it has already possessed, normalised, sorted out and stored up constitutes only a small part compared with the possible information sources which being the majority, remain disordered and scattered. There is a huge amount of raw information to be exploited and sorted out.

So far in our country, due to the level of development of the economy and the technology, traditional information systems by manual means, or the so-called Manual Information Network (MIN), have still held sway.

Quite a lot of jobs have to be done manually by the people who are professionals in economical planning or statistics work. The flow-chart is shown as following :



MIN

It is obvious that MIN is the basis of the entire information system. In order to ensure that quality of the information system, great importance must be attached to the MIN, the "bottleneck" of the information system. Otherwise the consequence would be "seriously accounting on a false accounts book", or "inputting garbage followed by ouputting garbage", which is too ghastly to contemplate.

II. MANUAL INFORMATION NETWORK

1. Characteristics of Information Structure

The new economical system needs to establish a new information structure which should be adapted to it. What new features should this new information structure have?

They include the following aspects :

a) Full exploitation of the source of information, especially the market information associated with the market system.

b) Reasonable information-flow structure. While ensuring the high and low conducting of information, it should be strengthened reversely conducting information from higher bodies down, supplying lower units with various types of information. Besides the above vertical information-flow, great efforts should also be devoted to the development of horizontal information-flow to form a criss-cross information network.

c) Pluralisation of information managing bodies.

In addition to professional information departments, information organisations will be set up by localities and other departments, and a lot of nongovernmental information managers will also be appointed. They should complement each other so as to form an information transmission system, sharing work and co-operating.

d) Conversion of information into commodities and establishment of information market. This is aimed at increasing accuracy, transmission speed and utilization ratio of information.

e) Deepened processing of information.

2. Manual Information Network

The State Economic Information System (SEIS) has been set up for only a short time, its coverage is not wide enough and its power is limited. In this situation, various kinds of MIN are springing up vigorously, becoming necessary and very valuable supplements to the SEIS. The following are some examples.

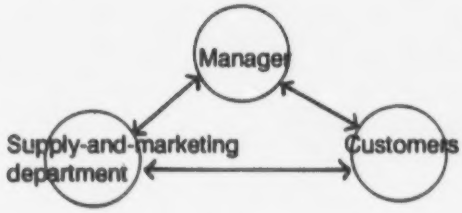
- Professional and sampling investigation contingents are important components of the MIN. Some typical examples of them are the rural investigation contingents, urban investigation contingents (both being subordinate to the Statistics Bureau) and the China Society Investigation System which was set up recently.

- The information exchange meeetings, held monthly by various associated government organisations, and all the periodicals and magazines on economic information can play a role in regularly interchanging economic information.

- The National Coordination Network for Prices Information carries out information exchange monthly.

- There are various fairs and meetings for orders.

- The most widespread supply-and-marketing system within every enterprise is a MIN connecting the manager, the supply-and-marketing department and the customers as shown below.



In our country, the original data of census and general industry survey is gathered through a special MIN (involving several million investigators), coming up level by level.

With special aims, all these MIN refine and summarise the data gathered, supply it to the concerned units in various forms and have achieved good results. Recently, from time to time, we can read such news in the newspaper as a "piece of information saved an enterprise" and "a piece of information creates a profit of up to a million yen".

These are the cases in question.

3. Some Problems with the present MIN in China.

There are some problems with our MIN to be resolved.

- Single channel : The information is collected and transmitted through the vertical administrative channel which is restricted by the economical made and management system. The information is mainly about planning, execution and supervisory service.

The horizontal economy information and international economic information are still not exploited.

- Poor dynamics: it chiefly relies on the statistics departments for gathering information; the data comes up all the way through many levels; the communication means are backward; work depends on the manual aspect. All these factors aggravate the time-lag and dynamics of the system, crippling the quick feedback ability of the system.

. Poor Predictive Ability: Statistics information is the result of investigation after a movement. The statistics report, the basic form of statistics investigation, has the feature of converging step by step. Therefore, time-lag cannot be avoided. Statistical Information is not capable of answering the question "What is happening now?" This fact is inacceptable. It is even more unable to answer the questions "What will happen?"

Besides , there are other problems: low credibility, low processing depth, repeated collection, difficulty in sharing and low utilisation ratio.

III. THE RELATIONSHIP BETWEEN MIN AND THE ECONOMIC INFORMATION SYSTEM

The key to the success of the construction of the economic information system lies on achieving real social economical effects which come from effective exploitation of the system function. The data base, the model library and the method library are the core of the application of the economic information system, with the data base being "the core of the core" and the basis for all application works.

The construction, development and operation of any data base system depend on the support of MIN. The quality of MIN, therefore, determines the success of the data base system.

From the system engineering point of view, in the development of a large-scale information system, especially EIS the main hazard of failure does not exist in technology itself, but in the interface between technology and management, or, it can be put this way:

"30% technology, 70% management and 120% basic data".

A powerful MIN and its organisation and management are some of the keys to information system construction. If the problems of information source exploitation, especially the problems of gathering and updating of data, were not solved properly, the information system might lead to a failure midway.

In analysing the difficulties in exploitation of information resources, generally, three types of situations can be listed :

1. An information channel exists, but the data are not completed and somewhat contradictory and scattered in various files, reports and manuals of different departments.

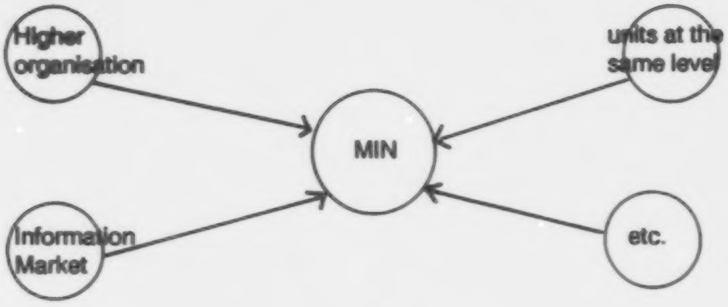
2. The information channel has not been dredged. Most information exists in grass-root units and cannot be obtained directly from existing statistics materials.

3. The information is to be exploited and sorted out.

These are a great barrier to the MIN.

To break down this barrier, experience shows that the MIN needs the participation and support of the top leader, that means, using administrative means. This is called "the principle of the chief" in the Soviet Union, or "Top Manager" in the United States. Without the participation and support of the top leader, the system would not succeed.

In China, there are three main paths for the supply of the data to the SEIS, higher organisations, units at the same level, information markets, which is shown below.



Another way to utilize this information is to attract the customers to take part in the construction of the information system.

Since the system actually serves the customers, they are aware of the problem to be resolved and what data is to be supplied.

They should be cultivated and mobilized to exploit the application of the system. The original customer's MIN should be pushed close to the economic information system. This is called "information for information, data for development".

To sum up, the economic information system is a man-machine system which gathers, stores and processes, analyses and exchanges the economical and social information using the means of modern science and technology, based on the present traditional information system.

Hence, in the procedure of EIS construction, attention should be paid to overcoming the weaknesses of the MIN.

That includes:

. Pushing forward standardisation, improving the quality of service,

. Altering the traditional working method, gradually improving MIN,

. Expanding the coverage of computer networks over the present traditional information network, continuously raising the level of automation in gathering economic information.

Thus, EIS will become more and more perfect, and its social economical effects will become more and more remarkable.

IV. CONCLUSIONS

To build up an EIS with Chinese characteristics, one of the keys is the MIN. So great efforts should be made in the leading, organisation, construction and management of MIN. We should do our best to improve MIN using modern science and technology, so as to make it more useful for various information systems, especially for EIS.

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WORKING GROUP F

MACROECONOMIC INFORMATION SYSTEMS AND THEIR USE BY GOVERNMENTS AND ENTERPRISES

Chaired by:
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Ren Limu
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Xue Huacheng
Zang Jipeng
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1. INTRODUCTION

Three main issues were discussed:

- the production of macroeconomic information,
- macroeconomic forecasts and projections,
- the dissemination of macroeconomic information.

2. PRODUCTION OF MACROECONOMIC INFORMATION

2.1. National Accounts Systems

National Accounts Systems (SNA and MPS) provide the general framework for the production and presentation of macroeconomic information. While these frameworks may appear to be satisfactory for the publication of national aggregates, and for international comparison, the working group felt that there were serious shortcomings in the systems when they are used for policy purposes. This is especially true in the context of developing countries where the data in the various components of the system is not always consistently reliable. For example, the aggregation of data from the formal sector and from the subsistence sector provides in many cases aggregates which may be misleading.

2.2. Sectorisation of National Accounts

In some countries, it may be necessary to distinguish between important sectors (e.g. oil production) and sectors which are less important. In others, the criteria for "sectorising" could be the reliability of the data available, while in others still, the speed at which data can be obtained could be used as the criteria.

The working group proposes that a specific project could be designed to produce a set of accounts for a pilot country which is not necessarily based on SNA and MPS classifications, but tailored to the needs and structure of the country.

2.3. Macroeconomic Information and Basic Information

Macroeconomic information always reflects the structure and quality of the information on which it is based. Thus priority must be given to improving the quality of the basic data.

2.4. The Bulgarian Experience

In Bulgaria, efforts have been made to develop an integrated system of economic information based on direct returns from economic units to the Information Systems Centre for a set of nationally prescribed indicators. For these indicators, the economic units need not supply information to any other Government organisation.

This approach, which can be compared with the Government Data Network approach of DFD, could serve as an example for producing macroeconomic information for the "modern" sector in a developing country.

3. MACROECONOMIC FORECASTING

3.1. Forecasts and Information

Macroeconomic forecasts are an integral part of economic information systems, independently of the agency which is responsible for preparing the forecasts. Forecasts provide a common language and a frame of reference for discussions of economic development.

3.2. Reviewing Forecasts

Although they are necessary, accurate macroeconomic forecasts are difficult to produce. It is common for agencies to carry out post-mortems of their forecasts at the end of a period, but it would be more useful if the forecasts could also be reviewed periodically.

It is essential to divide long-term forecasts into shorter-term components in order to be able to monitor and adjust the results periodically. It was suggested that one-year forecasts provide useful data to policy makers and management.

3.3. Disaggregated Subsystems

Greater emphasis should be placed on forecasts of disaggregated subsystems in order to meet high priority public sector user requirements. While it is not possible to forecast aggregates (e.g. G.D.P.) without adequately forecasting the various components (external trade, etc.) these component parts may be of higher priority than more aggregated data.

Management forecasts of disaggregated macroeconomic data (usually based on Management Information Systems) must be linked to macroeconomic forecasts.

3.4. New Approaches

It was noted that there was an increasing tendency for forecasts to be based on complex econometric models with little input from users, thereby reducing the possibility to take into account qualitative factors for forecasting. The use of modern technology such as knowledge-based systems and experts systems can be applied to economic forecasting in order to integrate both qualitative and quantitative factors. It was stressed that forecasting, based on any technology, should be closely linked to actual statistical data. The possibility for "forecasters" to download subsets of data from national databases is considered to be an important trend.

3.5. Pilot Project

The working group suggests that the pilot project in para 2.2. above should be extended to inlcude forecasts; these can then be used by policy makers.

4. DISSEMINATION OF INFORMATION

4.1. Information on Information

It was noted that unfortunately, many countries still did not have the means to disseminate adequately macroeconomic information, even in conventional forms (printed reports). While other techniques of dissemination (e.g. selective dissemination, access to data banks, etc.) can be investigated, it is very important to provide all potential users with a guide on what information is available and how to obtain it.

4.2. International Support

It was noted that many international organisations have a large amount of data on developing countries on their internal systems. It was suggested that this information could be given back in a form which is readable on microcomputers (e.g. diskettes or CD-ROM) to the Information Systems Services of developing countries in addition to what is already distributed or sold to large users.

A NEW APPROACH TO ECONOMIC DATA ACQUISITION AND PROCESSING

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1. INTRODUCTION

The changes in the economics and management in Bulgaria and the development of new information technologies require a new approach to economical data acquisition and processing. Enterprises and regional authorities have to decide on a large scope of problems and for that reason they need detailed information. On the other side, top management concentrates its functions on making strategic decisions requiring more aggregate information. There are more than 25 years of traditions in EDP in Bulgaria. Economical data processing has always held an important place. Starting with only statistical data processing, many enterprises had developed their management information systems. Several years ago a National Information System for obtaining and processing of daily economical data from the largest enterprises had been developed. There are 27 regional Computing Centres in the country, which are Centres for Infomation Systems and Technologies and which build the technical infrastructure for all national information systems. Data base management, Teleprocessing and Personal computers have been implemented during the last few years. Having this in mind results achieved, and the new requirements for a new technology for economical data processing has been developed. The technology is based on a new approach to the organisation of the economical data acquisition and processing which consists in

- Economic indicators which have to be specified selectively for each kind of enterprise in the production and non-production sphere according to the enterprise's activities and for each time period (monthly and above).

  This means that instead of the existing statistical input forms, which are more or less survey-oriented and have to be sent by all enterprises, a new way for data acquisition should be developed, so that each enterprise receives a list with only those indicators which represents its activities.

- Indicators with their values for previous time periods have to be separated from the input documents

- It means that output statistical forms have to be produced on the basis of stored economical data.

- Only primary data has to be obtained and all summarized and resulting data has to be automatically calculated.

- There must be a unified technology for obtaining and processing all economical data which is a matter of interest to all levels of management.

2. GENERAL CONSIDERATIONS

The following considerations have been taken into account:

- Data has to be gathered and maintained at once and used by many users at the same time
- Data processing has to be developed to information processing
- Information has to be provided to all management levels according to their needs and competence
- The technology has to give possibilities for changes in indicators methodology and content
- A distributed processing approach has to be applied
- Existing computing resources has to be used more effectively
- Statistical information has to be provided
- New information technologies have to be implemented.

3. DESCRIPTION OF THE TECHNOLOGY (Figure 1)

a) Data entry in the enterprise

Each enterprise receives a list with all indicators according to its activities and production. At the beginning of the time period (monthly, 3-months, 6-months and yearly) the planned values for each indicator are entered on a personal computer and they can be updated if necessary. At the end of the time period the current values are entered using one preprinted document, which includes only indicator code and name, measure unit and the current value (Figure 3). Using the personal computer and the developed software tools the enterprise management can receive current information about the results received represented by a set of indicators, including the ratio between planned and current values.

b) Data transfer

The data from each enterprise is transferred to the Regional Centres for Information systems and Technologies (RCIST) in on-line or off-line modes. On-line transfer requires a teleprocessing system and personal computer emulation as terminal. Off-line transfer is done using a diskette, containing the data from the enterprise or input documents are sent to the RCIST, where they are entered on a tape. Enterprises with Computer Centre could prepare their data on a tape and send it to the RCIST for further processing. Practically all possible ways for data entry could be used depending on the available configuration in the enterprise.

c) Data checking and error correction

Data checking is done first in the enterprise during the data entry. Next step in data checking is organised in the RCIST in dialogue mode. Using prestored information about all logical conditions, constraints of indicator values, indicators with values which might be incorrect are available for analysis and eventually error correction. Autotomatic error correction and data editing is also used.

d) Data Base organisation (Figure 2)

There are 3 data bases in the RCIST. First, one is created and permanently maintained a Meta Data Base, which includes:

- indicators description consisting of 15 parameters for each indicator (code, name, level of usage, measure unit, time series, time period, etc.) - indicators nomenclatures.

- algorithms and rules for computing aggregate indicators.

The second Data Base consists of the planned and current values of the indicators for each enterprise and the time series for predefined indicators.

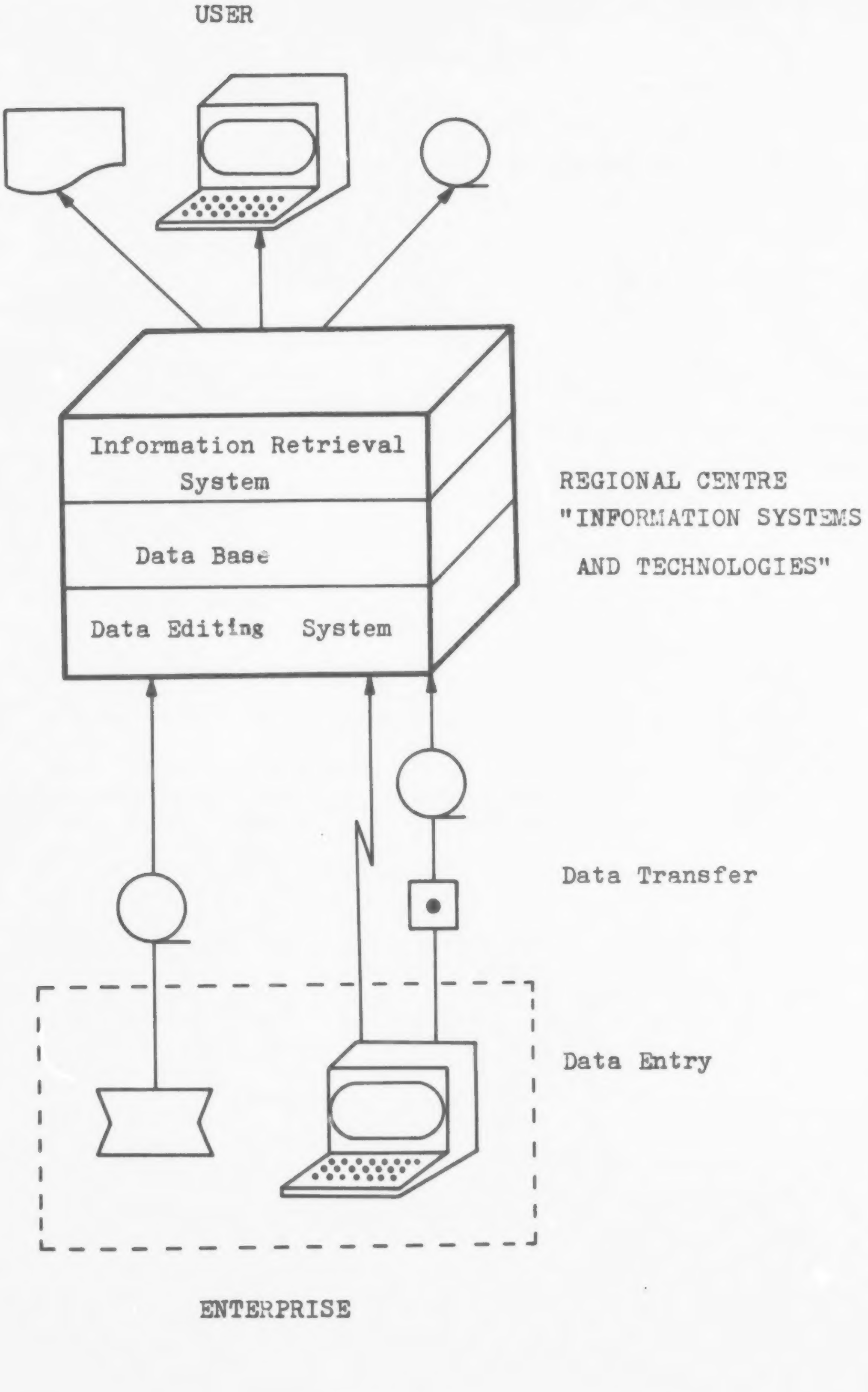

USER
Information Retrieval System
Data Base
Data Editing System
REGIONAL CENTRE "INFORMATION SYSTEMS AND TECHNOLOGIES"
Data Transfer
Data Entry
ENTERPRISE

Fig.1

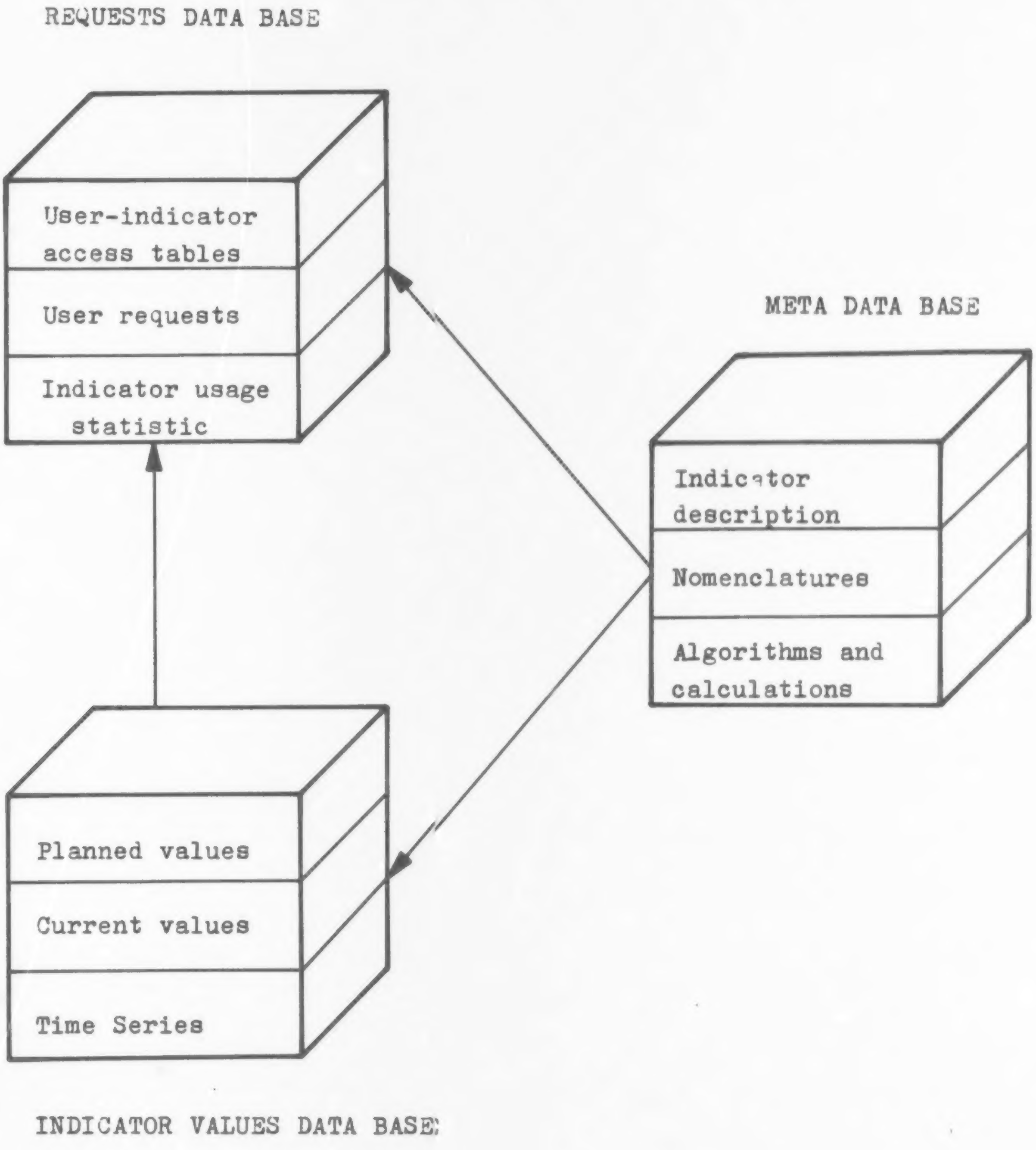
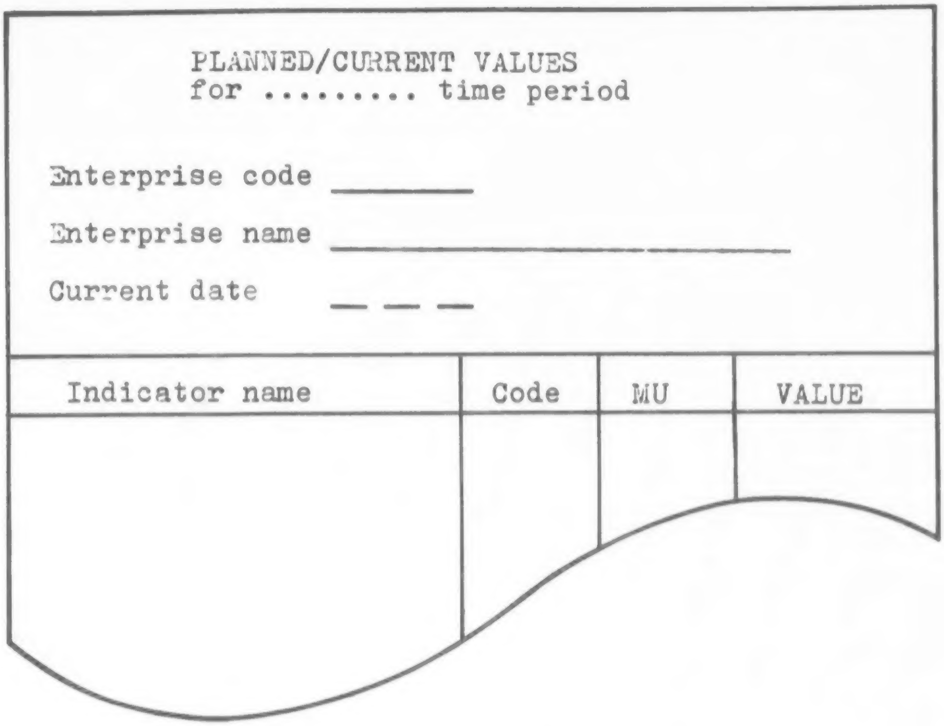

REQUESTS DATA BASE
User-indicator access tables
User requests
Indicator usage statistic
META DATA BASE
Indicator description
Nomenclatures
Algorithms and calculations
Planned values
Current values
Time Series
INDICATOR VALUES DATA BASE

Fig.2



PLANNED/CURRENT VALUES
for .... time period

Enterprise code ________

Enterprise name ________________________

Current date __ __ __

Indicator name	Code	MU	VALUE

Fig.3

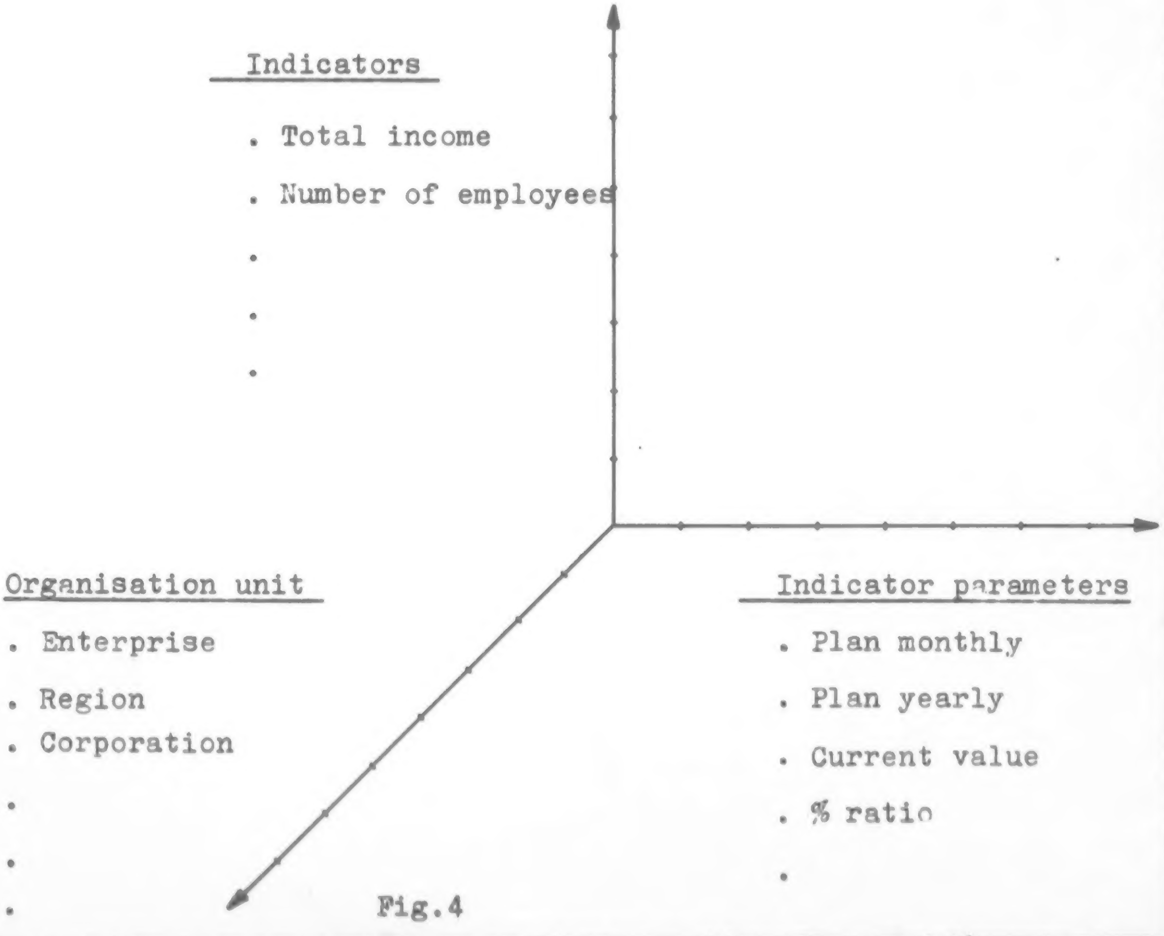

Indicators
. Total income
. Number of employees
.
.
.
Organisation unit
. Enterprise
. Region
. Corporation
.
.
.
Indicator parameters
. Plan monthly
. Plan yearly
. Current value
. % ratio
.

Fig.4

The third Data Base includes all user requests for information, the data security tables and keeps statistics permanently for the usage rate of each indicator.

All three Data Bases are maintained by the same DBMS and intercooperate with each other.

e) Information retrieval

The user is provided with a flexible Information Retrieval System (IRS) which allows him to specify every kind of request and to obtain in a short time the requested information on the screen or/and on sheets. Request processing is managed in dialogue mode and using a menu system with extended "Help"-facilities.The user can define a three-dimensional matrix for his request (Figure 4). He can specify an indicator or a set of indicators, then the organisational unit (enterprise, subordinate organisation, region, district, etc.) and at last the required parameters for the indicator (planned value, current value, ratio in percents, values for previous time periods etc.) The output is automatically created according to the individual requirements of each user.

f) Information utilisation

An extended feature of the system is a set of economic mathematical models and basic statistical functions, which are included in the RCIST and allows the user to use more effectively the economical information. On user requests in batch mode, special economic analysis, forecasting and statistical computations are done. The implementation of decision support tools like DSS and Expert Systems at users level is planned. For this reason a technology for transfer of a selected part of the Data Base to the user will be developed.

4. RESULTS AND FUTURE DEVELOPMENT

In 1987 the described technology was developed and experimentally implemented in one region for production enterprises and indicators with monthly time periods. In 1988 the scope of indicators and enterprises from the production and non-production sphere should be extended and a step-by-step implementation of the technology should start. From the technological point of view, the interface to existing Management Information Systems in the enterprises will be developed and AI tools on user level will be incorporated.

5. CONCIUSIONS

The new technology developed for economical data acquisition and processing has mainly the following advantages comparing it to the existing organisation of statistical data processing.

First, it is a unified approach to data acquisition and processing and can be used for obtaining and processing of every kind of socio-economical data. Second, data is stored in a data base, which decreases the number of data items by about 50% due to the prestored values for previous time periods for each indicator. Third, a flexible input and user-friendly output are provided recently decreasing the number of input documents and nonlimited number of output forms, including every kind of combination among indicators, their parameters, organisation units and the interrelations among them according to the user neeeds. Last but not least the new technology guarantees more accuracy and more realistic information which allows the management on each level to make more better decisions.

WORKING GROUP F - BACKGROUND PAPER

THE ESTABLISHMENT AND DEVELOPMENT OF THE CHINA ECONOMIC INFORMATION SYSTEM - THE NEED FOR INTERNATIONAL TECHNICAL CO-OPERATION

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The purpose of this paper is to describe the on-going Government programme of the China State Economic Information System, and its supported activities by the United Nations under the CPR:86:011 Project.(1) It is intended to call forth international technical assistance and co-operation in support of the Government efforts in this important undertaking, which will be discussed in the last section of this paper.

1. China State Economic Information System (CSEIS)

Within the context of the development strategy expressed in the Government's seventh Five-year Plan (1986-1990), CSEIS is under construction as a means of promoting China's social and economic development. Such an establishment is to suit the emerging needs of national development management and to meet the profound challenge of new technological innovation in information systems of the world.

The main features of the CSEIS are as follows :

- Collecting, updating, processing and storing various kinds of information related to national economic development;
- Compiling information and maintaining a database and an access system to allow selection, retrieval and manipulation of data;
- Analyzing and forecasting economic outlooks to assist decision-making by the State Council and its departments concerned with national policies and development strategies;
- Carrying out the development of, and coordinating and supporting economic information services at the national level as well as at provincial and local government levels; and
- Promoting an internatinal and domestic information exchange and service.

Figure 1 depicts the scheme of the CSEIS. There are two main characteristics of this system.

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(1)The CPR/86/011 project is financially supported by the United Nations Development Programme (UNDP), and technically back-stopped by the United Nations Department of Technical Co-operation for Development (UNDTCD). The project covers the period of 1986-1990.

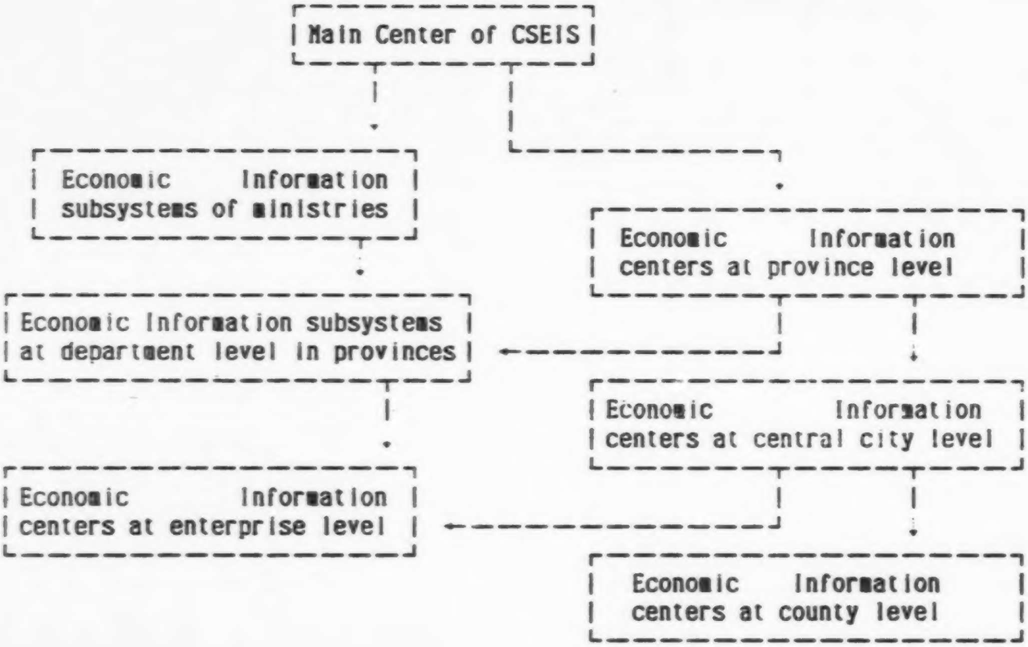
Main Center of CSEIS
Economic Information subsystems of ministries
Economic Information centers at province level
Economic Information subsystems at department level in provinces
Economic Information centers at central city level
Economic Information centers at enterprise level
Economic Information centers at county level

FIGURE 1. THE SCHEME OF CSEIS

(1) Centralization and decentralization

The system will be centralized logically in planning and design, and decentralized physically in implementation; and

(2) Horizontal coordination and vertical integration

On the one hand the system will operate on a horizontal platform through the participation of various ministries and agencies relating information on national development activities such as national production and consumption, finance and bank, natural resources and development, and international economic information. On the other hand CSEIS consists of four vertical levels: central government level, province level, central city level, and county and enterprise level, including special economic zones.

2. **United Nations Supported Project** (2)

The present project CPR/86/011 will be implemented in line with the development strategy in the Government's Seventh Five-Year Plan (1986-1990), which calls for transfer of technology in establishing CSEIS. However, its task is limited to assisting the Government's on-going effort of building ten model projects. It is intended that the results will later be spread throughout the nation to form a CSEIS which will enhance the efficiency of economic management methods. Specifically, the project is to strengthen the technical and managerial capacities in establishing and operating economic information systems in the State Planning Commission and other associated agencies including the State Economic Commission, the State Statistical Bureau, the Ministry of Foreign Economic Relations and Trade, and a number of selected economic information centers at provincial, city and county levels.

One of the special characteristics of this project is that in addition to the Government's contribution in kind, it integrates Government's cost contributions and UNDP inputs. It would ensure concerted efforts in establishing and improving CSEIS, and would facilitate easy implementation, co-ordination and monitoring of progress in the setting up of CSEIS.

Figure 2 is the organization chart of the ten model projects and their relations with CSEIS.

The State Economic Information Centre of the State Planning Commission was delegated to coordinate the implementation of these ten model projects. These ten model projects are as follows :

1. Document Databases of the State Laws-Regulations and the Economic Literatures on the Office Automation of the State Economic Information Centre
2. The Building Up of the Software Development and Training Centre
3. The Model Project of Xiamen Special Economic Zone

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(2) As early as 1975, the Government recognized the need for more sophisticated economic information services and accordingly stressed the need for learning experience and lessons from other countries. Since then, the Government has embarked on a number of international co-operation programmes on this subject on both a bilateral and a multilateral basis. Of the United Nations supports, particular reference should be made on the computerized tabulation of the 1982 Third Population Census, which was the first nationwide activity to process all data from this census by means of electronic computers. The project was financially supported by the United Nations Funds for Population Activities and technically supported by the UNDTCD.

At this point, it is worthwhile noting that this United Nations supported project as well as other international assistances have strengthened country self-reliance on information systems. The knowledge acquired and experience gained have built up the confidence and competence of national project authorities and correspondingly paved the path for initiating the present CPR/86/011 project.

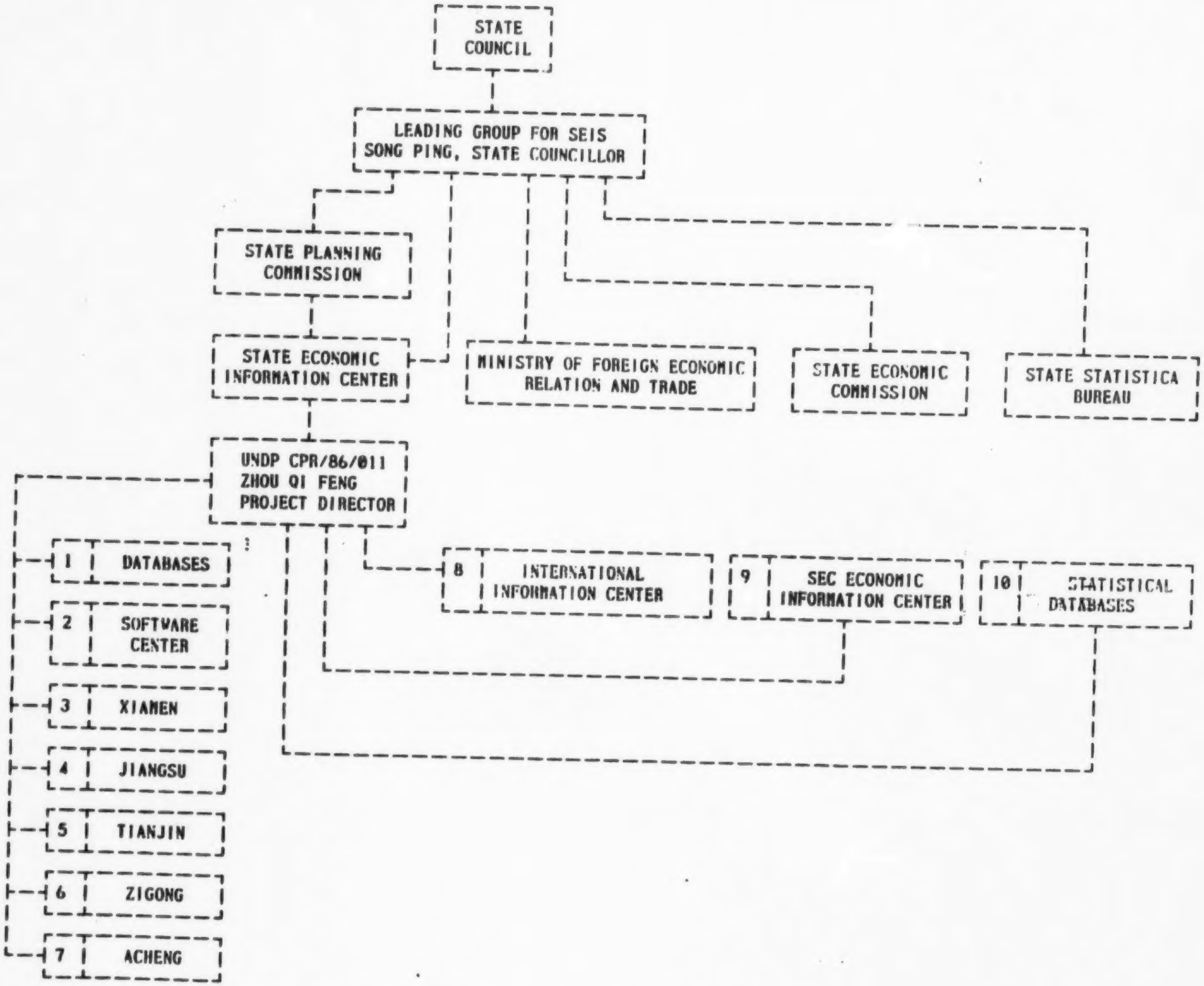
STATE COUNCIL
LEADING GROUP FOR SEIS SONG PING, STATE COUNCILLOR
STATE PLANNING COMMISSION
STATE ECONOMIC INFORMATION CENTER
MINISTRY OF FOREIGN ECONOMIC RELATION AND TRADE
STATE ECONOMIC COMMISSION
STATE STATISTICA BUREAU
UNDP CPR/86/011 ZHOU QI FENG PROJECT DIRECTOR
1 DATABASES
2 SOFTWARE CENTER
3 XIAMEN
4 JIANGSU
5 TIANJIN
6 ZIGONG
7 ACHENG
8 INTERNATIONAL INFORMATION CENTER
9 SEC ECONOMIC INFORMATION CENTER
10 STATISTICAL DATABASES

FIGURE 2. THE ORGANIZATION CHART

4. The Model Project of Provincial Economic Information System (Jiangsu Province)

5. The Model Project of Big Cities (Tienjin City)

6. The Model Project of Medium Cities (Zigong City, Sichun Province)

7. The Model Project of Economic Information System at County Level (Acheng County, Heilong Jiang Province)

8. The Establishment of Training System for China International Economic Information Center

9. The Pilot Project of Management Information System of the Economic Information Center Under State Economic Commission

10. Establishment and Development of the National Statistical Database of the State Statistical Bureau

3. Objectives and Activities of CPR/86/011 Projec

The development objective of the project is to assist the Government in establishing CSEIS, through the transfer of knowledge in the above mentioned ten model projects. The tasks will encompass a wide range of activities in setting up the information system and in gathering, processing and analyzing data for economic management and development plannning in the public sector. This information system will provide the information channels required to design and manage the process of economic reform, which is fundamental to the Government's current economic policy.

The immediate objective of the project is to assist the Government in building up know-how through a training programme, which will strengthen the capacities of the State Planning Commission and other associated agencies in establishing a number of model economic projects. The immediate project objectives can be categorized as follows:

(1) Development of a training programme capable of satisfying present and future requirements in the areas of economic information management

(2) Introduction of an assortment of methodologies and computer software packages in the fields of development administration, planning and statistics, for the purpose of storage, retrieval, and analysis of economic data to be held in various data banks;

(3) Transfer of expertise in the use of quantitative techniques for the calculation of economic indicators, which will enable policy makers to assess potentialities of the economy and to explore the effect of alternative policy settings;

(4) Assistance in the design and maintenance of databases, which will upgrade capabilities in the areas of system analysis and development of logical data models, selection, installation and use of packaged software, database optimization and administration, etc.; and

(5) Demonstration and introduction of modern equipment in the area of automatic information systems and related fields.

The project inlcudes two separate, but interrelated components: economic management and information systems. The former includes such areas as statistical analysis, economic management and quantitative planning techniques, and the latter compares database, office automation and network.

The transfer of know-how which the project is to provide, includes a combination of vigorous training abroad and in-service training which is to be provided by specialists/consultants. Specifically, these project activities will include the following :

(1) **Study tours.** Study tours to foreign countries are designed to learn the latest techniques and methods in operating the economic information system and to establish a dialogue with various institutes in designing a suitable method for China.

(2) **Individual fellowships.** Individual fellowships are intended to give the participants on-the-job training in the existing economic information systems for three months to one year. Focus is on practical training and not necessarily on attainment of academic degrees.

(3) **Experts.** Short-term consultants (three months maximum with possible repetition) will conduct formal training, and participate in the on-going work by evaluating what has been achieved and taking an active part in new development.

(4) **Equipment.** The equipment which is purchased under government execution - cost sharing and some UNDP funds, will facilitate the upgrading of the data processing capabilities in establishing an economic information system.

4. Priority Areas for International Technical Co-operation

CSEIS is a huge and ambitious task. The full achievement of actually building a fully functional CSEIS will require a considerably longer period than allowed by the China Seventh Five-Year Plan. Correspondingly, there is a need for international technical assistance in addition to the above-mentioned United Nations support.

The need for international assistance is particularly acute in view of China as a country with an underdeveloped economy, a vast territory and one billion people. In this connection, lack of funds, shortage of skilled experts and backward technology are the main constraints in the construction of CSEIS.

Based on self-reliance and open policy, we welcome international supports including both bilateral and multilateral co-operation to assist the Government in establishing CSEIS. The following priority areas are identified.

(1) Transferring technology as well as methodology. Technologically developed countries can assist in the creation of appropriate information systems and planning methodologies, which have to be tailored to China's specific national circumstances;

(2) Organizing joint training programmes, including both on-the-job training in China as well as training of Chinese fellows abroad;

(3) Exchanging information at mutual interests, including the state of development of national policy on economic information systems, bibliographic reference databases, and appropriate general purpose software; and

(4) Financially and technically supported selected pilot projects of CSEIS to demonstrate the design and implementation of both well-formulated information policies and information systems.